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In Memoriam.

SIR ROBERT JONES, Bart., K.B.E., C.B.

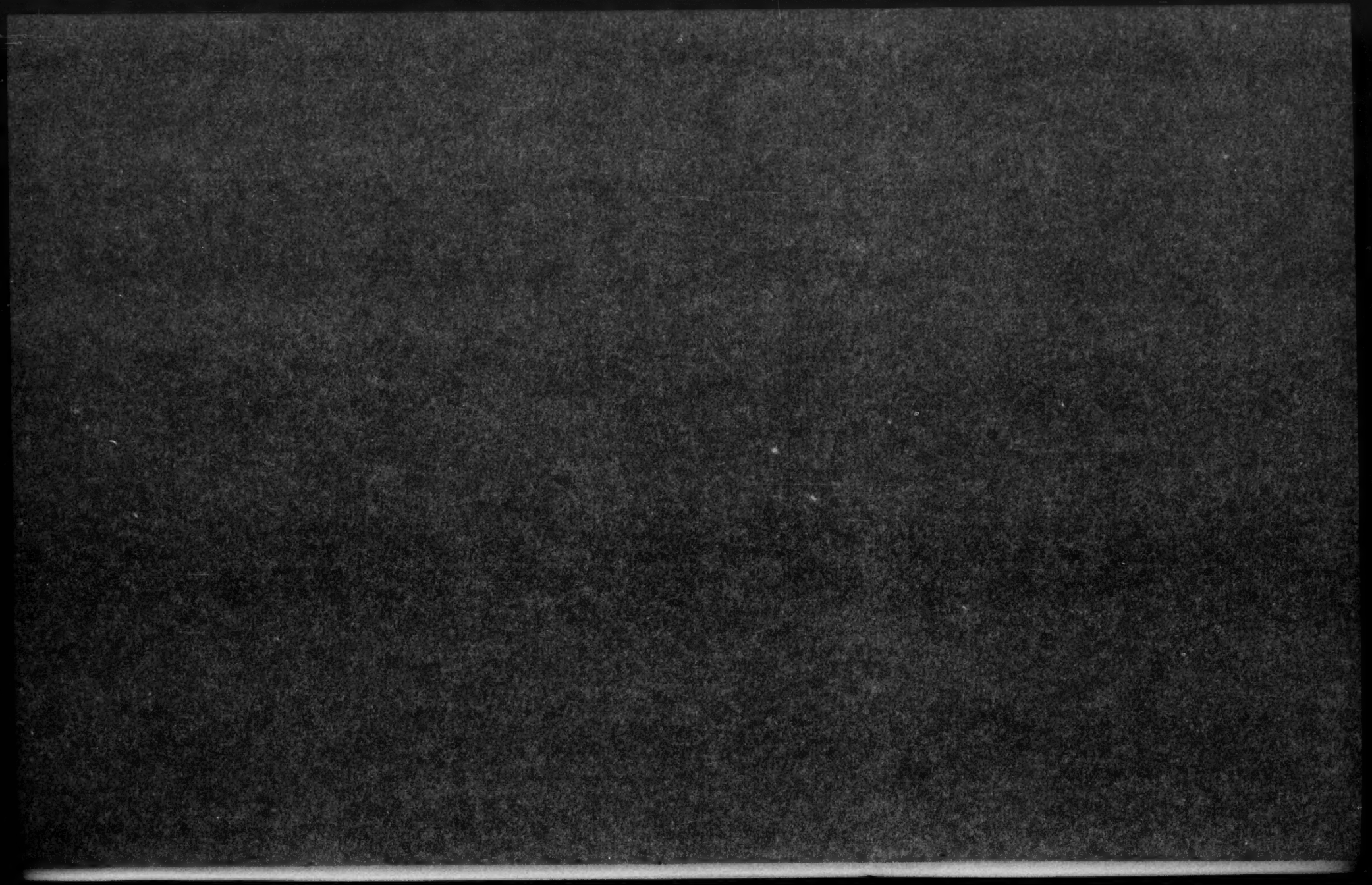
ROBERT JONES is dead. England parts in grief from one of her greatest surgeons and finest gentlemen; orthopædic surgery loses the supreme master.

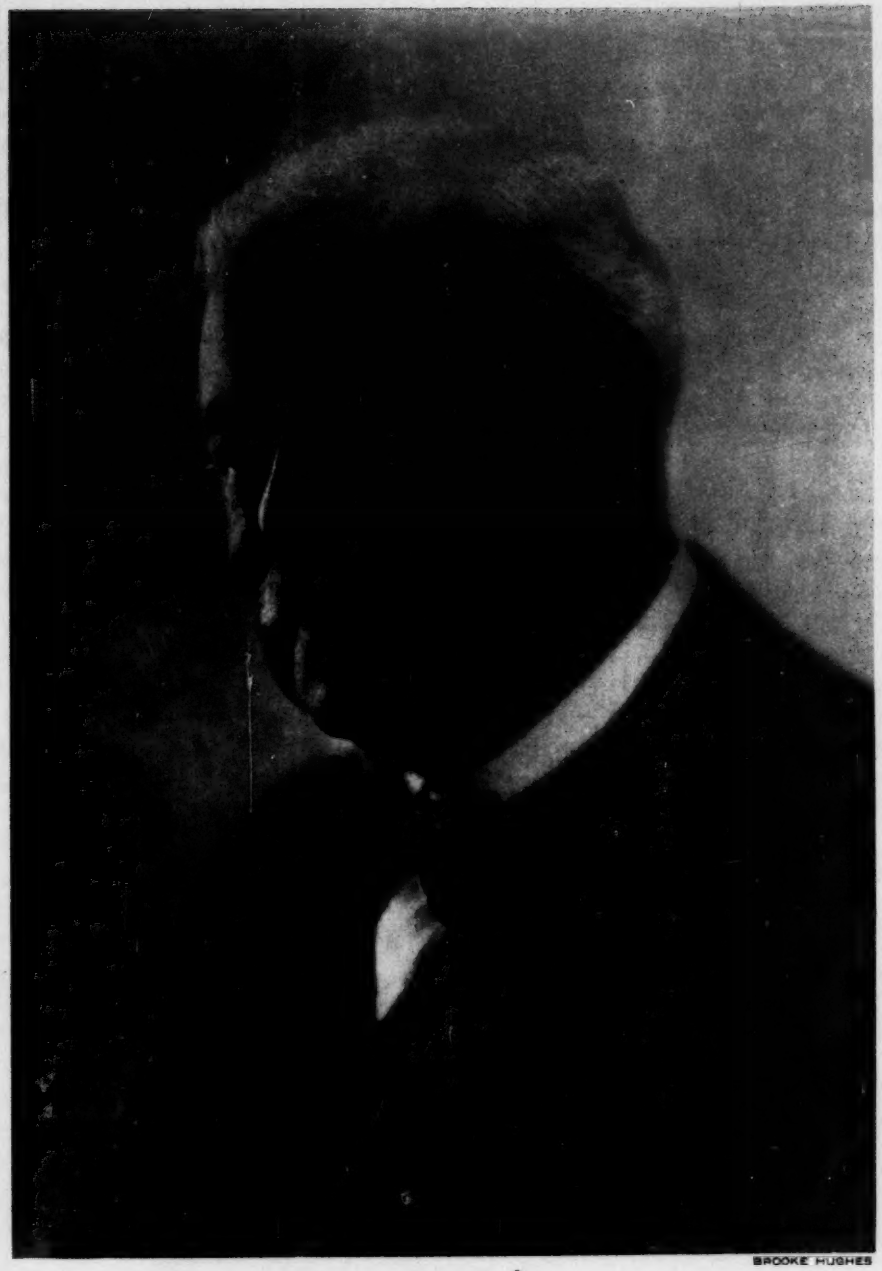
Robert Jones was born in 1858, qualified as M.R.C.S. twenty years later, and began practice in association with his uncle on the maternal side, Hugh Owen Thomas, one of the most original minds in surgery. Thomas was the son of a famous Liverpool bone-setter, who inherited a practice that had descended through seven generations from father to son. The partnership which existed between Thomas and his father, an unqualified practitioner, was severed by the Medical Act of 1858. Robert Jones was fortunate in this association. His uncle, to whose memory he was devoted, made him his disciple, transmitted to him a legacy of all the craftmanship the most expert of bone-setters had acquired, and kept his mind at work by the novel, even new-fangled, views and methods of which he never ceased to speak.

The Thomas's splints and wrench are only a small part of the inheritance bequeathed to surgery by this strange, eager, unconventional surgeon. The world at large took many years to recognize their value, for although the practice of Thomas, and later of Jones, was numerically the largest in the kingdom, few beyond the area of Lancashire, West Yorkshire, Cheshire, and North Wales had realized that two of the most remarkably gifted men were unceasingly at work, and that between them they had almost silently raised orthopædic surgery to a level incomparably higher than that reached in any other part of the world. It was not until a little over thirty years ago that we began to hear much of Robert Jones. American surgeons, beginning with the Mayos, used to visit Liverpool, Edinburgh, and Leeds, to see the work of Robert Jones, Harold Stiles, and Moynihan. The three heard much of each other, took opportunities to meet, with the result that, in order to afford easy occasions for like friendships among other provincial surgeons, a club was founded, which, meeting twice yearly, once at home, once abroad, soon created new friendships, increased intellectual traffic among its members, improved the technique and developed the skill of every surgeon engaged in teaching in provincial schools.

At that time the chief fault of Robert Jones was that, great though his accomplishments were, he was training no successor, and that much of his knowledge would die with him. Then came the War, and it required little experience of it to realize that a very large share of the work would be 'orthopædic' in character. Obviously the organization and direction of this work had to be entrusted to one man, and Jones's name was submitted to the Director-General. Even at that time his work was so little known to London surgeons that the news of the appointment, to which reluctant official consent was granted, was received with wonder and incredulity. There was never a moment's doubt as to the success Robert Jones would make of such an appointment. Here was the chance to remove the reproach of not training disciples and successors. The number of those who became his pupils, were trained in his methods, and inspired by his eager spirit, grew to thousands. First, however, it was necessary to define the scope of orthopædic surgery, and when the Army Council Instruction was drawn up the range chosen excited at first no little opposition. Finally, however, it was accepted, and then Jones's difficulties began. He had to find hospitals, and after a sharp conflict a newly built but as yet unoccupied institution at Shepherd's Bush was handed over, to become the headquarters of army orthopædic work. Orthopædic departments were quickly attached to all the largest and most important territorial hospitals, and a staff of physicians, surgeons, nurses, masseurs, and others trained for their special task. Understandings between our hospitals in France and at home were made, so that work at the front could be correlated with work at the base in France, both made appropriate to the opportunities there, and then brought into fitting association with work more deliberately done in England. Schemes to ensure the best treatment of every patient at each stage of his journey, say from Paschendale to Aberdeen, were carefully considered, judged by experience derived from visits made to every stopping-place on the journey and by examination of the accommodation and skill everywhere available, and if all were satisfactory, were then established as an ordered practice. All this required great administrative skill, infinite tact in smoothing away difficulties and placating objectors, and unceasing watchfulness to see that the gigantic machine never faltered. It was at the head of the Orthopædic Department at the War Office that Robert Jones found his destined place. He became the guide, the counsellor, the example to a large band of workers who quickly assimilated his teaching and were able to practise it on a scale hitherto unimaginable. The genius of Owen Thomas, the skill of Robert Jones, found their highest expression in service to our wounded. The methods of these two, previously little known and rarely practised, except by such old friends as Harold Stiles, Henry Gray, and Lynn-Thomas, now became the heritage and the enjoyment of all who cared to seek acquaintance with them.

Robert Jones then never lacked pupils, and multitudes of surgeons now in high places both in America and England will willingly bear witness that to him they owe a knowledge of their art they could not otherwise have acquired. His guidance, inspiration, and friendliness have given them an encouragement, an exaltation in their work, that nothing but their own





BROOKE HUGHES

SIR ROBT. JONES, BART., K.B.E., C.B.

life devotion to their task done as he would wish it to be done can repay.

It was a wonderful experience to visit Robert Jones and to see him doing his routine hospital work. On arrival one was presented with a list of twenty-five operations to be performed! Robert Jones worked with an almost incredible speed, and was supported by a team as efficiently trained as any one has ever seen. There seemed a silent conspiracy of united relevant effort in which every single person from surgeon to theatre porter took part. The surgical technique was flawless: there was none better in the whole world, and Jones enjoyed the distinction of being a fast operator whose technical methods had no weakness and did not give way under the strain of speed. There is far too often a sacrifice of safety to haste; speed should be the accomplishment, not the aim, of an operator. As Jones worked, the clock appeared to be losing time. There was no slightest suspicion of hurry. One act followed another in due order without fuss, without delay; before one was prepared for it the list of operations was completed, and one began to wonder whether anything could conceivably go wrong with such superb unapproached mastery of diagnosis, of perfection in technique, of infinite resource. Many of Robert Jones's methods were of his own devising; he would employ, almost without one being quick enough to notice it, a device which alone would have made the reputation of another man. He would fashion a splint, and make one feel that the pliant metal knew what was expected of it. He was, in fact, a consummate artist, in design and in accomplishment.

It is impossible to tell truly of the love his patients bore him. He was greeted by the children in the open-air wards at Heswall, not with quiet respect, but literally with a yell of delight. His manner to them all, his patience, tenderness, loving care, his sweetness and infinite gentleness, were a lesson to all. It may be doubted if any man ever won such love from patients as he did; his charm and kindness and compassion were infinite.

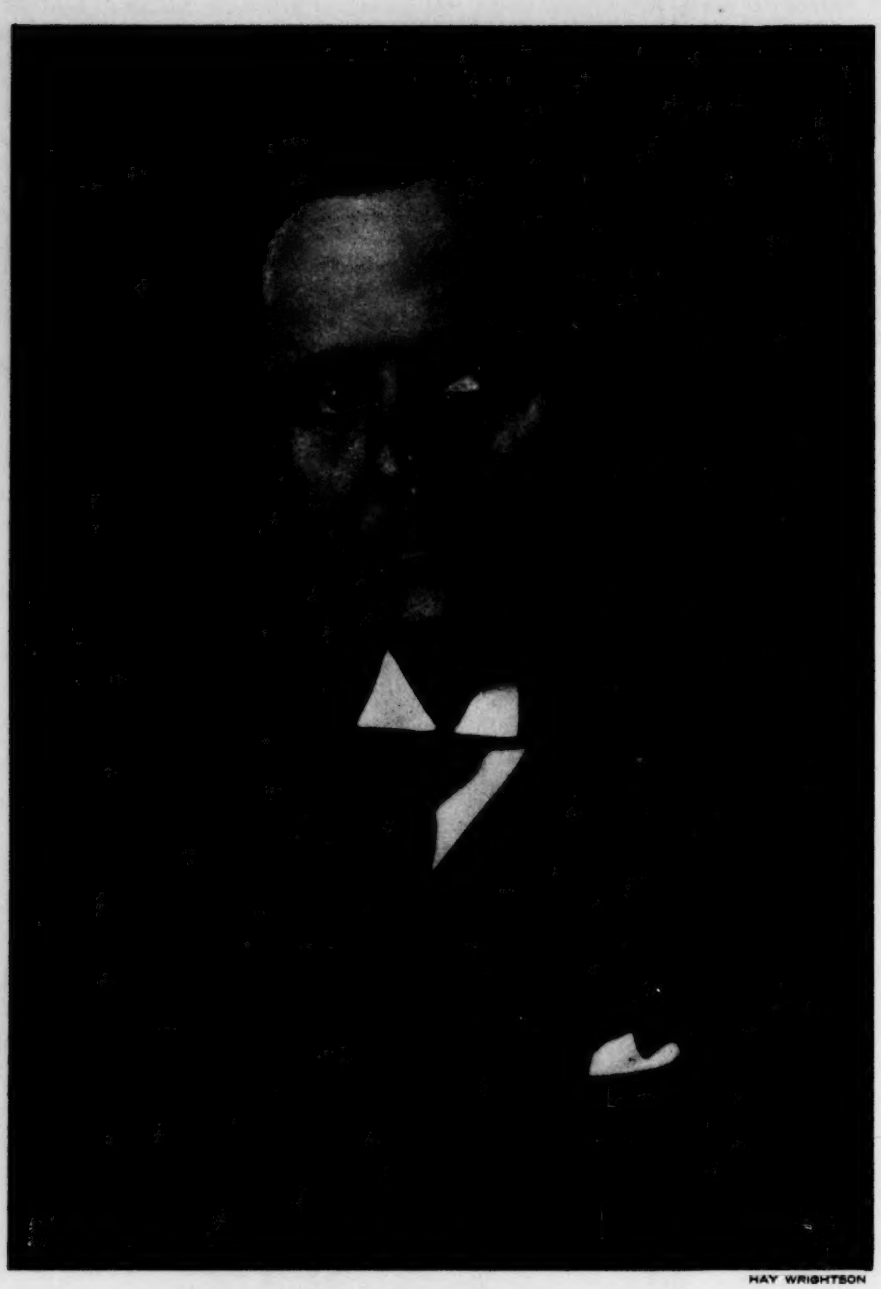
Robert Jones was a man of great physical power. Bones lost their strength when he bent or broke them. Twisted feet became supple, and as he moulded them took on a new and better shape. And he was above the tyranny of fatigue. He went from one task to another with the gay and inexhaustible sprightliness of youth, and wherever he went men's hearts were lightened, their courage strengthened and their joy increased, their ideals made more glowing.

On his seventieth birthday he was presented with a *Birthday Book* composed of original scientific essays, chiefly on orthopædic subjects, by twenty-five surgeons, his friends, pupils, and co-workers. These included eight London, five foreign, and three colonial surgeons. The book was presented to him at a special dinner, and the words of its preface, by his life-long friend Lord Moynihan, serve as a fitting epilogue to this article:—

> Spirit alone is immortal. In the practice of orthopædic surgery the spirit of Robert Jones will live for ever.
>
> The story of the triumphs of Robert Jones as prophet, high priest, and practitioner in orthopædic surgery makes plain the reason for our deep respect. Our affection for him transcends, if it be possible, our gratitude for his professional

worthiness. Few man have ever possessed in so radiant a degree the genius for friendship. No one can be long in his company, none can work with him or play with him, without realizing not only the sweet simplicity of his character, but the greatness of his heart. He speaks ill of no man. He seeks and finds good in all things and in all men. He sets an ideal and a standard of action in friendship which all strive to reach when with him. In a long and very intimate friendship I have never heard an unjust criticism, a cruel jibe, or a word of bitter cynicism on his lips. He covers his displeasure or stern disapproval by silence, or a restrained reproof that is often weightier than a torrent of words from others. His personality radiates cheeriness, good temper, and good will. All men are attracted by him, and in war-time conflicting temperaments found in him something that appeased their differences, assuaged animosities, and encouraged a desire for friendliness. He was then called upon to rule in various places, over colleagues at first unfriendly, openly antagonistic, indifferent to his rule, or incredulous of his practice. We were all amazed at his success in overcoming very real difficulties by gentleness, sympathy, a true understanding of the minds of others, and a tactfulness which in times of crisis was almost magical.

It is the simple truth to say that within the memory of the present generation no man in our profession has been so deeply, so universally, beloved. He was the perfect friend.



HAY WRIGHTSON

SIR PERCY SARGENT, C.M.G., D.S.O.

SIR PERCY SARGENT, C.M.G., D.S.O.

PERCY SARGENT was born in 1873 and educated at Clifton College. From Cambridge he went to St. Thomas's, where he won the University Scholarship in 1895. He was House Surgeon in 1899 and Resident Assistant Surgeon in 1903. To his seniors at the hospital Sargent's talents became very obvious while he was House Surgeon. Even at this date he showed that skill and dexterity for which he subsequently became famous; he also showed an independence of thought that was usually tempered with a respect for the opinion of others. While holding the post of Resident Assistant Surgeon the qualities he displayed made it certain that he would become a member of the staff, and to that position he succeeded in 1905.

A little later Queen Square were looking about for a Junior Surgeon, and Sargent was chosen to carry on the tradition of Horsley. To this end he applied himself with vigour and enthusiasm. It is uncertain whether the choice of cerebral surgery arose spontaneously or whether the chance of a post at the National Hospital turned his thoughts in this direction; possibly the association with Ballance influenced his choice. Be that as it may, the Great War found him with a developed technique made up of rapidity, gentleness, and precision, which contrasted somewhat with that which is practised in some quarters to-day.

With Gordon Holmes he formed a neurological unit which led towards a better knowledge of localization of functions in some parts of the brain. He returned to London before the end of the war and took charge of a department for those still suffering from remote injuries of the nervous system, and eventually became Consulting Surgeon to the Ministry of Pensions.

He played a large part in the reorganization of his School which was necessitated by the disturbances caused by the war, and here his alertness and enthusiasm found a further outlet.

Although Sargent chose a special line of work, he never let it push general surgery into the background, and he continued to the end as interested in general surgical problems as any of his colleagues. He had a good judgement and was never the heroic surgeon in spite of his quickness and dexterity. He never strove after advertisement by publication, and that which he wrote was clear and to the point.

He gave the Erasmus Wilson Lecture at the College of Surgeons in 1905, was elected to the Council of that College in 1923, and was Vice-President at the time of his death. Ever since 1923 he has been a most active member of the Editorial Committee of this JOURNAL, and his kindly help to younger men in the presentation of papers as well as his critical judgement in the conduct of the JOURNAL will be difficult to replace.

Sargent was at most times very receptive and keen to try new methods and new technique, but he never adopted permanently any mechanical aids to operation; this was largely due to his manual dexterity.

He was a good colleague, intensely interested in and loyal to his School; this attitude appeared to make him at times a little blind to its imperfections and the perfections of others; perhaps this blindness was intentional. Sargent had sound friends; he also had that valuable gift of getting on with strangers. He was a cheerful companion with a rather piquant and trenchant way of putting things, but somehow the things he said never rankled, and this was true not only of his private conversation but of his performances on public social occasions, when he could be daring.

He was never a robust man, and a physical disability told heavily on him at times, though it was hidden from view. Perhaps it was this acquaintance with periods of ill health that made him interest himself in those on whom misfortune had fallen.

THE TREATMENT OF TUBERCULOUS DISEASE OF THE HIP-JOINT.*

By A. S. BLUNDELL BANKART,
ORTHOPÆDIC SURGEON, MIDDLESEX HOSPITAL, ETC.

During the last twenty-five years we have seen the growth and development of a most elaborate and costly system of treatment for surgical tuberculosis in general, and for tuberculous disease of the hip in particular. Large special hospitals have been provided in many places for the prolonged constitutional and local treatment of this disease. At these hospitals open air, sunshine, artificial light in some cases, special diet, education, and amusement have been combined with the most careful and painstaking conservative treatment of tuberculous joints for periods varying in different cases from one to five years. Yet, in spite of all this, some of us are profoundly dissatisfied with the results of the treatment of tuberculous hip. It is true that from some quarters we hear of wonderful results with high percentages of cures and perfect restoration of function; but this is not the experience of most of us, and frankly we are sceptical.

Actually we see case after case of active tuberculous disease of the hip which becomes quiescent or apparently cured under modern conservative treatment, and then after a longer or shorter interval—it may be years—it becomes active again and requires further treatment. It is abundantly evident that in such cases the disease has never been cured but has been latent and a constant source of danger to the patients in later life. What the percentage of these cases is, we do not know; but it is so considerable that some people doubt whether tuberculous disease of the hip-joint is ever cured by conservative treatment. I must confess that after a long struggle against what I thought was my better judgement, I have come to much the same conclusion.

Great stress has been laid upon the fact that tuberculous arthritis is a metastatic infection secondary to a primary (usually glandular) focus of disease elsewhere. This is true, but I think that it is misleading to speak of a tuberculous hip or knee as a local manifestation of a general disease.

The normal pathological course of a tuberculous lesion tends to make it extravascular, and, except in cases of multiple and miliary tuberculosis, where the defensive mechanism has completely broken down, it would seem to be extremely improbable that "showers of tubercle bacilli" are poured into the blood-stream with any degree of frequency. Rather would I suggest that tuberculous arthritis is a metastatic infection due to the accidental detachment of a minute tuberculous embolus in the course of the extension

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* Presidential Address to the British Orthopædic Association, London, July 27, 1932.

of the primary lesion. Except in the cases of general dissemination that I have mentioned, such an accident is not likely to be repeated often, and the comparative rarity of multiple joint tuberculosis is in accord with this view. A tuberculous hip or knee is as much a local disease as is the primary focus, wherever that may be. It is true that the treatment of the one alone will not cure the other, but that does not mean that neither should be dealt with locally, if accessible.

We hear little of tuberculin nowadays, and it appears to be generally out of favour in this country; but a few physicians to my knowledge are using it still in selected cases with good results. This brings me to the point that if tubercle bacilli are not regularly poured into the blood-stream, their toxins certainly are, and the effects of tuberculin thus self-administered are not unimportant.

A tuberculous focus of some sort, usually healed and encapsuled, is found post mortem in about 100 per cent of adult bodies. It is probable that the possession of such a focus is an advantage to most of us, because of the immunity which we develop from small doses of tuberculin. On the other hand, large excessive doses of tuberculin are known to be harmful and dangerous, since they lower the resistance of the body to infection and favour the spread of the disease. It is not unreasonable to suppose that the removal of one considerable area of tuberculous infection may have a beneficial effect upon another and perhaps less accessible focus of the same disease, as well as on the individual as a whole, by enormously diminishing the dosage of tuberculous toxin that is absorbed into the general circulation.

The pendulum swings. Twenty-five years ago we saw a reaction against the prevalent practice of so-called excision of the hip and its appallingly bad functional results. During the last twenty-five years we have seen the rise and fall of so-called conservative treatment, and its failure to cure tuberculous disease of the hip. To-day there is a reaction again in favour of more radical treatment in this disease. Some surgeons, notably Hibbs of New York, are doing arthrodesis of the hip in practically all cases, and some of our own surgeons are following the lead of Hibbs. It remains to be seen whether the abolition of movement at the hip-joint will cure tuberculous disease of the *pelvis*.

This brings me to one of the most important considerations in the pathology of tuberculous hip—namely, Pugh's observation that the disease begins commonly in the inner portion of the ilium immediately above the acetabulum, and that it spreads from that point to the non-articular portion of the acetabulum and through the ligamentum teres to the head of the femur. Tuberculous disease of the hip is, in fact, tuberculous disease of the pelvis, and if it does spread to the hip-joint, so that the affection of the joint dominates the clinical picture, that does not alter the fact that we are dealing with pelvic disease. The old so-called excisions of the hip were not excisions of the hip-joint at all, but consisted merely in removal of the head of the femur, leaving the principal seat of the disease untouched. Modern fusion operations, particularly those of the extra-articular or mainly extra-articular type, which do not entail disarticulation of the head of the femur, also do nothing to remove the principal seat of the disease in the acetabulum, and, theoretically at any

rate, by preventing the ascent of the femur, they must also prevent closure of the tuberculous cavity which always exists as the result of bone destruction.

I should like to compare these fusion operations on the hip with similar operations on the spine, for it seems to me that the principles involved are not dissimilar.

Tuberculous disease of the spine begins characteristically in the anterior part of the spinal column, and it leads to destruction of portions of two or more adjacent vertebral bodies. The cavity thus formed by the destruction of bone is filled with soft tuberculous material. Natural cure of spinal caries occurs, and can only occur, by collapse of the contiguous vertebræ. The vertebra or half vertebra immediately above the disease sinks down to the vertebra or half vertebra immediately below it, obliterating the cavity and squeezing out the soft tuberculous material, so that solid bone comes into contact with solid bone, and union can then occur between them. Anything which prevents collapse of the vertebræ in spinal caries will prevent obliteration and healing of the tuberculous cavity, and will therefore prolong the disease indefinitely. The older surgeons of a couple of generations ago knew this well, and they liked to see what they called a 'good deformity' in spinal caries, for they knew then that the disease would be soundly healed. Conversely, they disliked what they called 'flat backs' in spinal caries, for experience taught them that such cases ran a protracted course and were generally unsatisfactory. We learnt the same lesson again in the early days of spinal fusion, when Albee's operation was done with more enthusiasm than judgement in many cases before collapse of the vertebræ had taken place. I myself had experience of two such cases—both of them adults with disease limited to two lumbar vertebræ, and thought at that time to be ideal cases for spinal fusion. Both operations gave immediate satisfactory results, followed by recurrence of signs of active disease within a year, and, so far as I know, these cases have never healed. It is fortunately hard to prevent collapse of the vertebræ in spinal caries by any means short of operation, and the results of conservative treatment are therefore generally good in spite of some misguided efforts to prevent deformity.

The problem of tuberculous hip is not essentially different from that of spinal caries. The disease begins, at least in many cases, in the iliac portion of the pelvis immediately above the acetabulum, and by its extension to, and destruction of, the roof and floor of the acetabulum and the head of the femur, it leads to the formation of a cavity filled with soft tuberculous material, bounded above by the undestroyed bone of the ilium and below by what remains of the head or neck of the femur. As in spinal caries, the only way that such a cavity can heal is by collapse or bringing together of the adjacent bones so that the tuberculous material is squeezed out and solid bone comes into contact with solid bone. Here also anything which prevents collapse of the bones and obliteration of the cavity will lead to the establishment of a chronic tuberculous cavity—encapsuled it may be, and quiescent perhaps for years—but unhealed and a constant menace to the patient.

Thirty years ago Lorenz maintained that ankylosis with sound healing was the best result that could be obtained in tuberculous disease of the hip. He contrasted the poor results obtained by the usual methods of traction and

weight-relieving with the natural cures that frequently occurred in untreated cases when weight was borne upon the limb. He remarked that in the remote Alpine districts of Austria many children with this disease went without any treatment whatever, and that they healed, with deformity it is true, but with sound painless ankylosis, so that they were able to run, jump, and climb mountains without fatigue or distress. Only when military service or marriage was contemplated did they come for treatment, not on account of disease, but solely on account of their deformities. From these observations Lorenz began his weight-bearing treatment of tuberculous hip, which consisted essentially of a plaster spica to prevent movement, but to allow walking on the limb as soon as possible. Abscesses he treated by aspiration, and deformities, when the disease was healed, by subtrochanteric osteotomy. In the fifteen years from 1899 to 1914 he treated about 800 cases by this method, and he was convinced of its superiority over methods of traction and weight-relieving.

Looked at in the light of present knowledge, it is clear that we have here a process analogous to collapse of the vertebræ in spinal caries; for weight-bearing forces the head of the femur up into the acetabulum and tends to obliterate the cavity formed by the destruction of bone; the tuberculous material is squeezed out, and bone then comes to bone. It must, however, be admitted that the mechanical conditions for complete obliteration of the cavity are less favourable here than they are in the spinal column.

We may now ask whether a so-called extra-articular arthrodesis is likely to help or to hinder such a process. Theoretically it would seem probable that, if an arthrodesis is done before the tuberculous cavity is obliterated, it will tend to prevent healing of the disease, assuming that the fusion is sufficiently firm to prevent ascent of the femur. In practice, however, there are two circumstances which offset this theoretical objection. The first is that most of the cases now done are comparatively late cases in which collapse of the bones has already occurred; and the second is that the recognized after-treatment of arthrodesis is to get the case up early—that is, before the artificial fusion could possibly be strong enough to prevent ascent of the femur under the stress of weight-bearing.

Pertinent questions arise from these considerations. For instance, how much of the success of extra-articular arthrodesis is due simply to the effect of weight-bearing in a plaster spica, as advocated by Lorenz thirty years ago, and how much, if any, of it is due to the added complication of an operation which does not touch the seat of the disease, and which by itself could not possibly produce a weight-bearing fusion inside many months? In a word, is extra-articular arthrodesis for tuberculous disease of the hip merely another name for the old Lorenz treatment of thirty years ago?

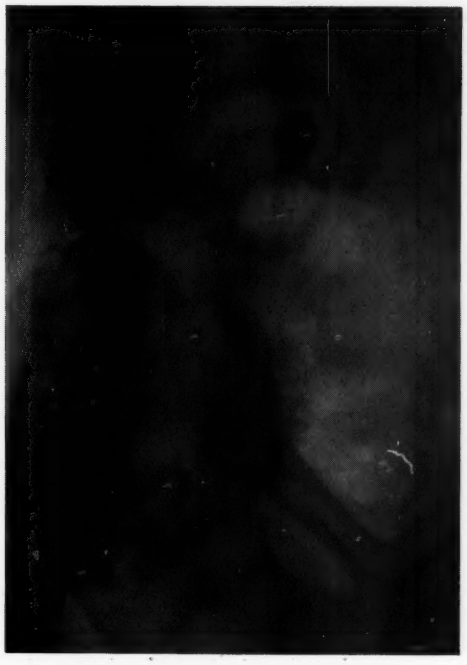
I will leave others to debate that academic point, and I will pass on to one which interests me personally much more. Is it true that in the present state of surgery an ankylosed joint is the best result that we can hope for in tuberculous disease of the hip? I think that orthopædic surgeons are rather inclined to make light of the disability of an ankylosed hip. They tell us how well the patient walks, how active he can be, and how free from pain. All this, of course, is true in comparison with the disability of an unhealed tuberculous hip. But I do not think that anyone would view with equanimity

the prospect of his own child having an ankylosed hip for life, whatever the cause; and, if it is possible with safety to preserve the functions of this large and important joint, surely that should be the aim of modern surgical treatment.

During the last few years a number of cases of late recurrence of activity in old and supposed healed tuberculous hip have come under my care. I have brief notes of nine such cases here.

CASE REPORTS.

Case 1.—Mrs. W., a heavy stout woman aged 62. The patient had tuberculous disease of the right hip at the age of 3 years. She remembers little of her early treatment, except that she had no operations, but she had sinuses on the front of the hip, which remained open until she was 12, and then they healed. She remained well



FIGS. 323, 324.—*Case* 1. Skiagrams showing condition before and after operation.

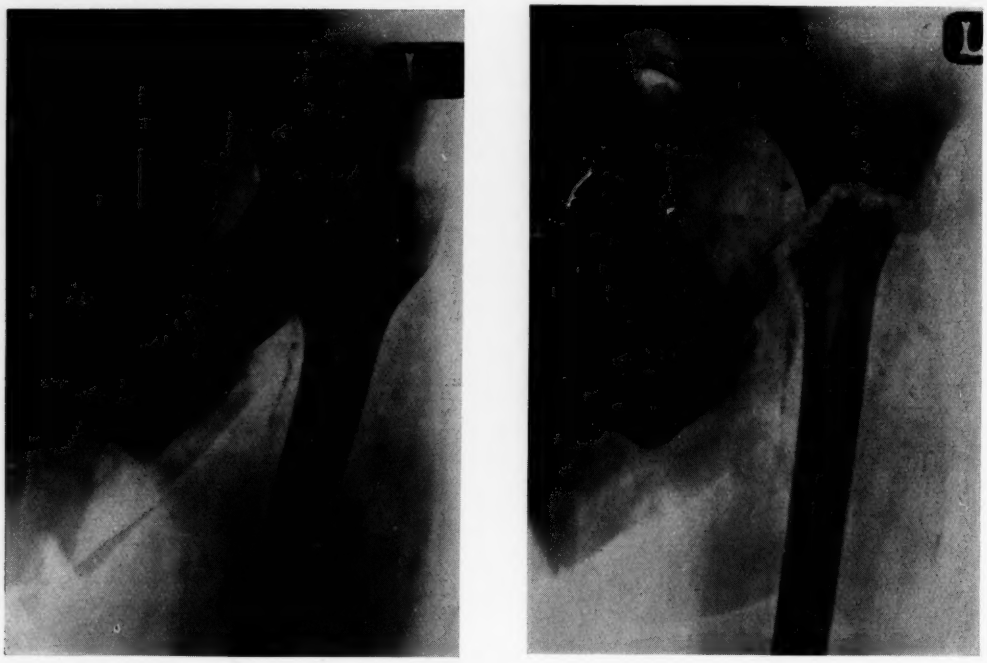
until she was over 50; got married (no children); was able to get about freely, and was not conscious of any disability whatever. She wore a shoe raised 3 in. under the heel.

In 1915 (age 48) she had an attack of sciatica on the right side, and after that occasional pain of the same character. In 1926 (age 59) she had severe pain in the hip. She was in hospital for six weeks on extension, but it made her worse, and she returned home. In 1927 a large abscess presented in front of the hip, and it was opened by her own doctor. Her general condition deteriorated, pus poured from the incision in front and from counter-openings that had been made on the inner side of the thigh, and albumin appeared in her urine.

In this condition I found her at the end of 1929, when I was asked to see her. X rays (*Fig.* 323) showed extensive disease of the acetabulum, extending up into the ilium above the level of the sciatic notch, and into the adjacent parts of the pubes and ischium. The upper end of the femur was also invaded by the disease.

OPERATION.—I operated on Dec. 20, 1929, excising the acetabulum and all the adjacent infected bone. The ilium was divided horizontally at the level of the sciatic notch, and the rami of the pubes and ischium were divided below the disease. The femur was sawn across below the trochanters, and its upper end, which was a thin shell filled with caseous material, was removed. The upper end of the shaft was implanted on to the divided surface of the ilium (*Fig.* 324). No attempt was made to deal with the large chronic abscess cavity which extended into the inner side of the thigh. The operation wound was left widely open and packed from the bottom. Perhaps I may add that the incision was made through 3 in. of dense indurated tissue, and no normal anatomy was encountered until the bone was exposed. The limb was put up in plaster in abduction.

Now after two years this patient has a stable painless hip on which she can stand and walk without assistance. The hip can be flexed to 80° and there is also



FIGS. 325, 326.—*Case* 2. Skiagrams showing condition before and after operation.

considerable movement in other directions. There is still a little thin serous discharge from the two sinuses on the inner side and from the one where the wound was packed for many months. But I believe that these sinuses are in the indurated soft parts, and I do not believe that this patient has any active or latent tuberculous disease of the hip now. Her general condition might almost be described as robust. Incidentally, she declares that her leg is no shorter than it was before, and that she is quite comfortable in the same shoe that she wore before. This, of course, is due to the correction of the adduction deformity.

Case 2.—H. F., a woman aged 30. First attended the Royal National Orthopædic Hospital in 1916 at the age of 16, complaining of pain in the back after exertion. Her history was that she had tuberculous disease of the left hip at the age of 3, and she was treated for four years at the Sevenoaks Hospital for hip disease. Since then she has got about freely and has made no complaint of her hip.

It was noted that she was an old and apparently healed case of tuberculous hip, with 1½ in. shortening, and a well-marked dorso-lumbar compensatory scoliosis.

The pain in the back was of the aching character that is often associated with this type of scoliosis. There was no sign of active disease of the hip. She was ordered a spinal support, which relieved her pain, and she wore it for four years.

Ten years later (July, 1930) she again attended the Orthopædic Hospital, complaining this time of pain in the left hip. The hip was fixed in flexion and adduction. There was very little movement, and this was painful. X rays (*Fig.* 325) showed extensive disease of the acetabulum, extending into the ilium above it, and destruction of the head of the femur.

Operation.—I operated on Oct. 21, 1930. The acetabulum was excised with the adjacent part of the ilium, and the upper end of the femur was removed. The shaft of the femur was implanted on to the cut surface of the ilium (*Fig.* 326). The wound healed by primary union, and she was discharged on Feb. 9, 1931 (four months after operation), walking in a long plaster spica with the aid of crutches. A short spica was substituted for this in May. In June, 1931, this was removed, and

Figs. 327, 328.—*Case* 3. Skiagrams showing condition before and after operation.

she walked without support of any kind. (*Note.*—I think that the period of fixation in this case was much too long; but, owing to the extensive removal of bone, I was afraid of a sudden displacement of the femur into the pelvis. Unfortunately the patient overheard a remark to this effect, and, as she admitted afterwards, it made her nervous and slow in trusting her weight on the limb.)

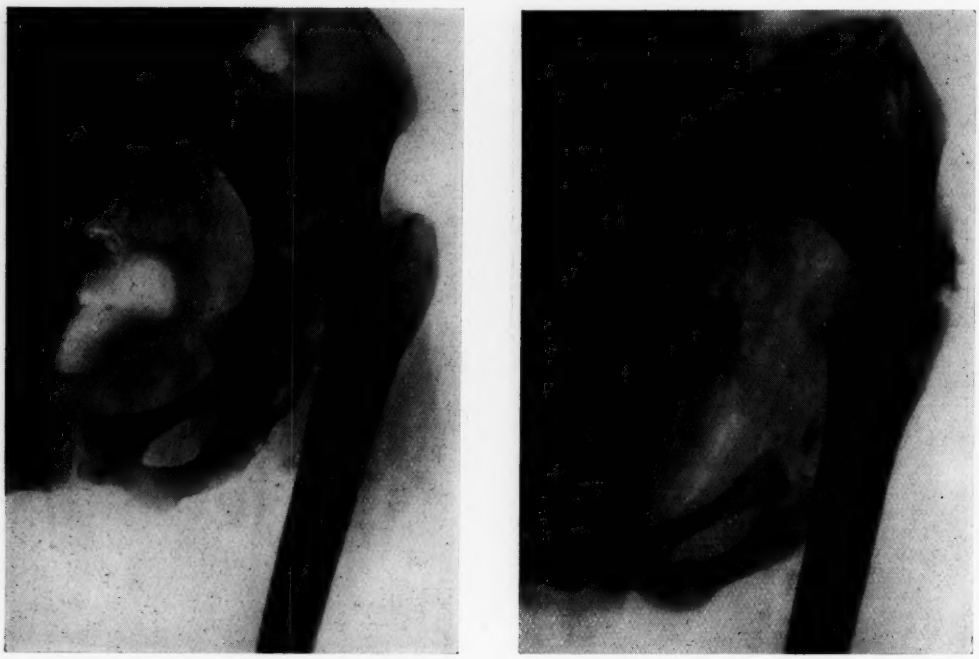
This patient now has a stable painless hip on which she can walk without assistance. There is movement up to 45° or more of flexion, and there is just under 3 in. of shortening.

Case 3.—F. de W., a woman aged 23. First seen at her home on Sept. 3, 1931, where I found her in bed suffering from acute pain in the right hip, which had come on on the previous day. She was terrified of being touched, and a detailed examination was impossible. The hip was fixed by spasm in 30° flexion. There was no obvious swelling of the joint. The temperature was 99° She was given an injection of morphia, and was sent in an ambulance to the Middlesex Hospital. There she was given an anæsthetic and the limb was put up in plaster. X rays (*Fig.* 327)

showed extensive disease of the right hip-joint, with a large abscess cavity containing a sequestrum in the ilium above the acetabulum, and partial destruction of the head of the femur.

The patient denied any trouble with the hip in childhood. She first had pain in the hip two years previously after playing in a lacrosse match. She then had acute pain in the night, and was unable to walk in the morning. It gradually got better, but she has been lame ever since. In spite of this she still played games and was able to ride. During the last four months she wore a belt, but the pain gradually got worse, culminating in the last acute attack.

OPERATION.—I operated on Oct. 10, 1931. The ilium was divided transversely above the abscess cavity and the upper half of the acetabulum was removed, with part of the head and neck of the femur (*Fig.* 328). The wound was closed without drainage.



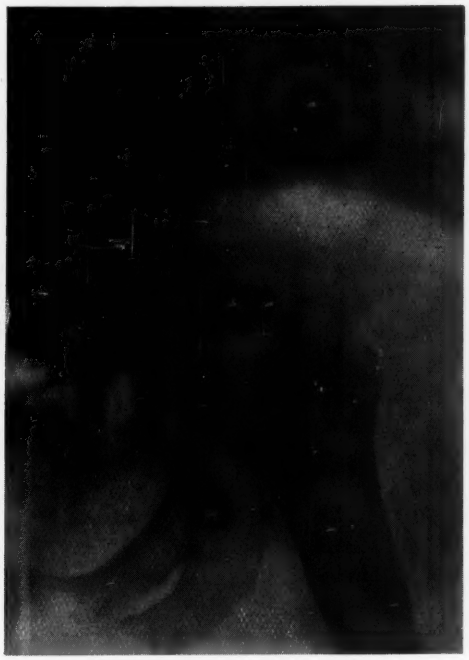
FIGS. 329, 330.—*Case* 4. Skiagrams showing condition before and after operation.

The limb was put up in a long plaster spica for four weeks, after which a short spica was put on, and the patient was discharged walking in this plaster on Nov. 18, 1931. The plaster was removed on Dec. 1 (note that this patient was walking in plaster five weeks after the operation, and without support of any kind in seven and a half weeks.) At the present time she has a stable painless hip on which she can walk without assistance. There is flexion movement to 40° or rather more, and about half the normal range of abduction, adduction, and rotation. She is comfortable with a 1½-in. lift under the heel. She uses a stick when she is out, but she walks indoors without one.

Case 4.—M. F., a woman aged 26. The patient was treated at the London Hospital for tuberculous disease of the left hip at the age of 8 years. She was in a Thomas splint for eighteen months. The disease was quiescent for two years and then she had a severe relapse. She was in a splint again for two years, and then walked on crutches for another year. She was then 15 years old. From the age of 18 onwards she worked in an office, and had no further trouble with her

hip until May, 1931, when, at the age of 26, she had sciatic pain and a large abscess presented in front of the hip. On examination the left lower limb was wasted and 4 in. short and there was a large abscess in front of the left hip. Flexion was free and painless up to 90°; other movements were practically absent. She had no pain except after walking, and then it was felt at the back of the hip and on the inner side over the adductor muscles. X rays (*Fig.* 329) showed extensive disease with cavitation of the acetabulum and of the ilium above it. The disease also extended into the ischium. The head of the femur was destroyed. The patient was admitted to the Middlesex Hospital on Nov. 27, 1931.

OPERATION.—I operated on Dec. 5, 1931. The acetabulum and the adjacent parts of the ilium and ischium were excised, and part of the head and neck of the femur was removed (*Fig.* 330). The wound was closed without drainage, and the limb was put up in plaster. A short plaster spica was put on on Jan. 9, 1932, and



FIGS. 331, 332.—*Case* 5. Skiagrams showing condition before and after operation.

she was got up five weeks after operation. (This plaster was removed on Feb. 16, ten and a half weeks after operation.)

At the present time she has a stable painless hip on which she can walk without assistance. There is flexion movement to 90°, and full range of abduction, adduction, and rotation. There is 4 in. shortening (which she says is less than she had before).

Case 5.—H. G., a man aged 54, a tailor. The patient had tuberculous disease of the left hip with abscess at the age of 10 years. Sinuses discharged from the front and outer side of the thigh, and eventually healed, but broke out again from time to time. The last abscess previous to the present illness occurred twenty years ago at the age of 34.

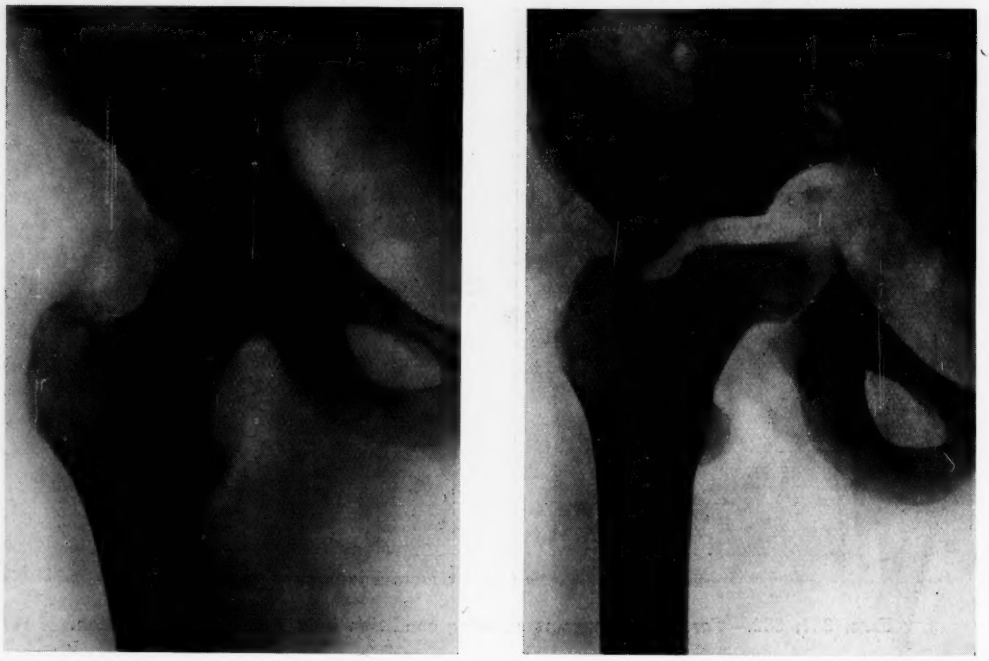
On April 28, 1931, he attended the Middlesex Hospital complaining of recurrent attacks of pain in the left hip, cramps in the leg, and inability to walk. The hip appeared to be firmly fixed in 30° of flexion and adduction. There was 2 in. shortening. There were scars of old sinuses in the groin and on the outer side of the thigh.

No evidence of a recent abscess. He was ordered rest, and he disappeared into the country for six months.

On Nov. 10, 1931, he came back, complaining again of pain in the hip, and an abscess was found over the back of the great trochanter. X rays (*Fig.* 331) showed extensive disease of the acetabulum and head of the femur.

OPERATION.—I operated on Dec. 12, 1931. The acetabulum and the head of the femur were excised. A large abscess was opened, and a sequestrum was removed from the roof of the acetabulum (*Fig.* 332). The wound was closed without drainage. The limb was put up in plaster in abduction. On Jan. 22, 1932 (six weeks after operation), he was discharged walking in a short plaster spica. This was removed on Feb. 16. There was then about 10° of flexion movement at the hip. Subsequently a small sinus opened in the scar, which discharged slightly and the hip became practically ankylosed.

At the present time this patient has a stable painless hip on which he walks well without assistance. There is practically no movement. He is comfortable with a 1½-in. lift under the heel.



FIGS. 333, 334.—*Case* 6. Skiagrams showing condition before and after operation.

Case 6.—N. H., a woman aged 21. Attended the Middlesex Hospital on Dec. 9, 1930, complaining of pain in the right hip of about two years' duration. The pain had come on gradually when she was 18 or 19 years old, and it had gradually got worse. It was especially severe at night. There was no history of injury or of previous trouble with the hip.

On examination the right hip was held in a position of slight flexion and adduction. Flexion was possible from about 30° to 90°; all other movements were abolished. There was little wasting of the thigh muscles, marked wasting of the glutei, no obvious deformity or abscess about the hip, and half an inch or less of shortening. X rays (*Fig.* 333) showed destruction of the acetabulum with cavitation, and an indefinite outline of the head of the femur.

OPERATION.—I operated on Jan. 10, 1931. The acetabulum and part of the head and neck of the femur were excised (*Fig.* 334). A large abscess in the pelvis,

containing tuberculous pus and melon-seed bodies, was evacuated. The cartilage of the head of the femur was found detached and lying free in the joint. The wound was closed without drainage, and the limb was put up in a long plaster spica.

The patient was discharged walking in a short plaster spica on Feb. 28, 1931 (seven weeks after operation). This plaster was removed on June 16. At the present time she has a stable painless hip on which she can walk without assistance. There is movement up to 90° of flexion, and full range of abduction, adduction, and rotation. There is 2 in. of shortening.

Case 7.—B. W., a girl aged 16. Attended St. Bartholomew's Hospital in May, 1929, complaining of pain in the left hip. A diagnosis of tuberculous arthritis was made, and she was sent to the Sevenoaks Hospital for Hip Disease, where she was treated for three years. Eventually an extra-articular arthrodesis of the left hip

FIG. 335.—*Case* 7. Skiagram showing condition before operation.

was done at that hospital on April 28, 1931. During her convalescence after this operation she complained of stiffness and pain in the right hip, and she was admitted to the Royal National Orthopædic Hospital under my care on March 7, 1932.

On examination the left hip was firmly ankylosed in the fully extended position. On the right side all the movements of the hip were limited and painful, and there was muscular spasm and wasting of the thigh and gluteal muscles. X rays (*Fig.* 335) showed extra-articular arthrodesis of the left hip, and what we took to be early destructive arthritis of the right hip.

OPERATION.—I operated on March 15, 1932, excising the acetabulum and the head of the femur (*Fig.* 336). The wound was closed without drainage, and the limb was put up in a long plaster spica. The plaster was cut, and movements were begun three weeks after operation. The patient was got up and began to walk on May 10 (eight weeks after operation) without support of any kind.

At the present time this patient has a stable painless hip and she walks well in spite of the stiff hip on the other side. There is movement up to 45° of flexion on the operated side, and about half the normal range of abduction, adduction, and rotation. There is less than 1 in. of shortening.

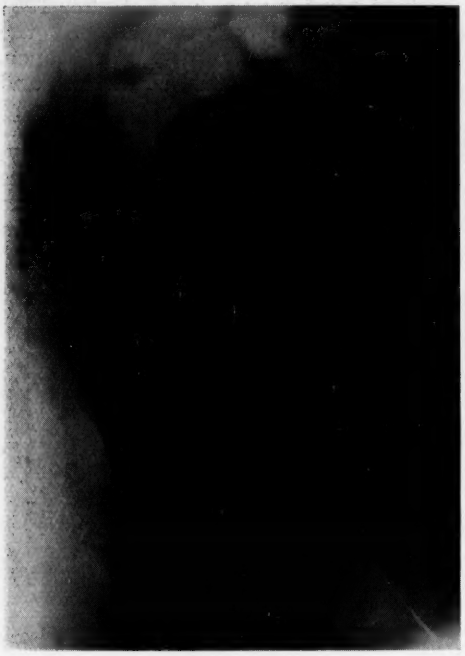


FIG. 336.—*Case* 7. Skiagram showing condition after operation.

Case 8.—S. G., a man aged 42. Complained of sudden onset of pain in the right hip in May, 1931. He had had no previous trouble with his hip. There was no history of injury. He was in a provincial hospital for several weeks with night sweats and a high temperature. His appendix was removed, but the pain continued. X rays (*Fig.* 337) showed rarefaction of the floor and inner part of the roof of the acetabulum.

After the patient's discharge the pain gradually increased in severity and he was re-admitted to the same hospital in January, 1932. He now complained of severe shooting pains down the right leg, and he was put in a Thomas's splint with extension. X rays (*Fig.* 338) showed an extension of the rarefied area in the floor and roof of the acetabulum.

He was transferred to the Orthopædic Hospital in March, 1932. On examination his general condition appeared good. There was no history of tubercle in his family. He denied venereal disease, and the Wassermann reaction was negative. There was an indefinite swelling around the right hip, and the great trochanter was prominent. All movements of the joint were limited and painful, and he could not raise the limb from the bed. X rays (*Fig.* 339) showed subluxation of the head of the femur with erosion of its upper margin, and extensive disease of the acetabulum and adjacent part of the ilium.

OPERATION.—I operated on March 29, 1932. The capsule of the joint was nearly an inch thick, and the joint itself was filled with solid tuberculous material which was scooped out in lumps. The acetabulum and the head and neck of the femur were removed (*Fig.* 340). The wound was closed without drainage and the limb was put up in a long plaster spica. The front of the plaster was removed in two weeks, and movements were begun. He was got up without support of any kind on May 18 (seven weeks after operation).

At the present time this patient has a stable hip on which he can bear his full weight without pain, although he still uses two sticks for walking. There is movement to 45° of flexion, abduction and adduction about normal, and rotation to about half the normal range. There is a little more than 1 in. shortening.

Case 9.—H. S., a man aged 41. Had tuberculous disease of the left hip at the age of 6 years. He had several operations, and was in hospital until the age of 10. Since then he has had no trouble with the hip, except that it was stiff, for thirty years. In November, 1931, he complained of pain in the left knee. In January, 1932, he complained of pain in the left hip. On examination there was a well-marked flexion and adduction deformity of the hip; practically no movement; little pain in the hip; considerable pain in the knee; marked wasting of the thigh muscles; scars of old operations about the hip. X rays (*Fig.* 341) showed unhealed old-standing disease of the left hip with destruction of the acetabulum and head and

FIGS. 337, 338.—*Case* 8. Skiagrams showing successive stages before operation.

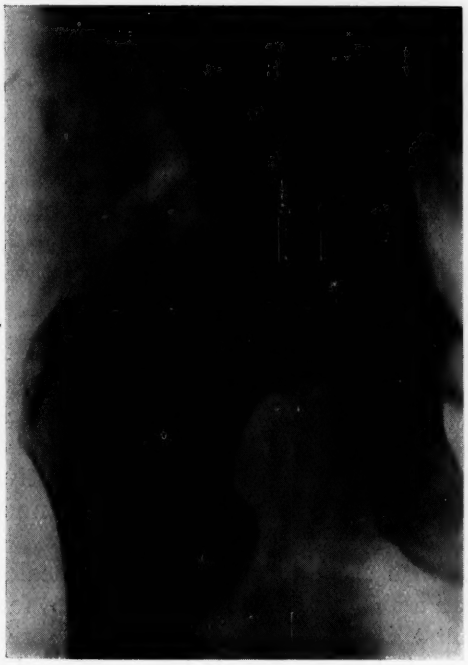
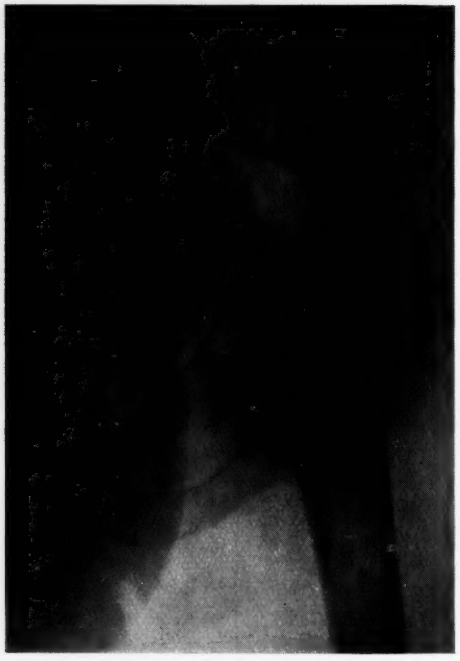


FIG. 339.—*Case* 8.
Later stage before operation.

FIG. 340.—*Case* 8.
Condition after operation.

neck of the femur. In February, 1932, a small abscess opened and left a sinus in one of the scars on the front of the hip.

OPERATION.—I operated at the Orthopædic Hospital on May 3, 1932. The acetabulum and the upper end of the femur were excised, and the upper end of the shaft of the femur was implanted on to the cut surface of the ilium (*Fig.* 342). The wound was closed without drainage, and the limb was put up in a long plaster spica. The plaster was removed in eleven days, and he was got up on crutches on June 16 (six weeks after operation). He was discharged on July 15 walking with sticks and with the boot raised 1 in.



FIGS. 341, 342.—*Case* 9. Skiagrams showing condition before and after operation.

COMMENTARY.

It is not suggested that these recent cases represent final results, but I think they may serve as a basis for discussion and perhaps as a stimulus to further investigation.

It will be noted that the dominant feature of all these cases has been *pelvic disease*, quiescent or latent for years, but certainly never cured, and I would suggest that this is a common, if not the usual, result of the conservative treatment of tuberculous hip. In all these cases I believe (though I cannot prove) that the local disease has been removed completely.

With the exception of the first case with secondary infection, all healed by primary union. *Case* 5 later developed a sinus, which discharged for a few weeks, and it is perhaps noteworthy that this is the only case in this series in which ankylosis occurred. With the exception of the first two cases also the period of convalescence has been remarkably short, the patients being got up and walking in from five to eight weeks after operation. All the patients

now have stable painless hips, and, with one exception, at least some degree of useful movement.

One cannot help wondering whether these patients would have been any the worse off, or whether they would not have been spared many years of hospitalization, chronic invalidism, and recurrent disability, if they had had their disease removed at the beginning, instead of at the end of their illness. In other words, now that the bubble of conservatism has been pricked, and the futility of striving for a literal cure has been exposed, might not a more rational surgery be applied to the treatment of tuberculous disease of the hip in children ?

To many, no doubt, the suggestion that we should return to radical surgery in the treatment of tuberculous hip will appear reactionary and horrible. We shall be told again that tuberculous hip is a local manifestation of a general disease, and that local surgery will not cure it. We shall be reminded that operative treatment has been extensively tried in the past and has proved a failure. From some quarters we shall hear again of the wonderful cures that result from open air, heliotherapy, and general conservative treatment, and the exceptional case will be put forward to prove it.

We have thought of all this, and we are still unconvinced. We do not believe that tuberculous hip is a local manifestation of a general disease. The inadequate operations of the past have nothing whatever to do with present-day surgery. The results of conservative treatment, as we know them, are profoundly disappointing, and I would submit that the time has come for a general reconsideration of the methods of attack in this disease. I would suggest that early excision of the focus of disease in the ilium might be considered as a rational method of treatment, and my experience of late cases leads me to believe that many cases might be cured at an earlier stage, and with a good prospect of preserving useful movement at the hip.

The operation is admittedly a severe one, requiring careful selection of cases and adequate precautions against shock. A reasonable rapidity in operating should be achieved, and I regard a blood transfusion running concurrently with the operation as essential. With these precautions the operation has as a rule been remarkably well borne.

Since this paper was first written I have had two disappointments which must be recorded. The first was a boy, 8 years old, with tuberculous disease of the left hip. At operation the disease turned out to be much more extensive than was anticipated, and at one stage there was troublesome bleeding from the internal pudic artery. The patient died a few hours after operation. The second case was a girl, aged 13 years, with tuberculous disease of the right hip. The operation was uncomplicated, but the patient died suddenly a few days later from pulmonary embolism—an accident which I do not know how to anticipate or prevent.

ACCIDENTAL LIGATION OF THE HEPATIC ARTERY.

REPORT OF ONE CASE, WITH A REVIEW OF THE CASES IN THE LITERATURE.*

By ROSCOE R. GRAHAM and DOUGLAS CANNELL, Toronto.

Accidental ligation of the hepatic artery is fortunately rare. Twenty-seven cases have been reported in the literature up to date. The rarity of the lesion and the complete investigation carried out prompts the presentation of this report.

CASE REPORT.

W. W., male, age 49, was admitted to Dr. R. R. Graham's service of the Toronto General Hospital on Nov. 5, 1930, with a right inguinal hernia, hæmorrhoids, and a slight prolapse of the rectum. During the course of routine history and physical examination, a pyloric carcinoma was diagnosed and confirmed by radiological examination. Accordingly on Nov. 12, 1930, following the usual pre-operative preparation, a partial gastrectomy was done.

A moderately extensive pyloric carcinoma was found, with enlarged lymph-glands extending upward into the gastro-hepatic omentum and along the lesser curvature of the stomach, almost to the œsophagus; glandular enlargement in the gastrocolic omentum was not extensive. There was marked inflammatory reaction and induration of the gastro-hepatic omentum which extended along the anterior border of the foramen of Winslow. The pylorus was freed after division of the gastrocolic omentum. The vessels along the superior border of the pylorus were isolated, divided, and ligated. During this procedure a large vessel which was enmeshed in inflammatory adhesions was divided and tied. It was immediately thought that the hepatic artery had been severed. Subsequently more careful examination following the closure of the duodenal stump confirmed this belief. Approximately one inch of the hepatic artery had been removed at a point about one and a quarter inches from its origin in the cœliac axis. The operation was completed in the usual manner, a posterior end-to-side retrocolic gastrojejunal anastomosis being done. No changes were noted in the liver during the operation. The abdomen was closed in layers without drainage, and the patient returned to the ward in good condition. Post-operatively continuous intravenous saline was given by the drop method, supplemented with the usual sedatives. Blood-sugar (*Fig.* 343) and non-protein nitrogen estimation (*Fig.* 344) were done hourly for the first four hours and at greater intervals thereafter. These showed no marked variation from the normal. The Van den Bergh reactions were negative throughout, and small quantities of urobilin were detected in the urine only the day preceding death.

Clinically the patient progressed favourably for the first three days. The evening of the fourth day his temperature rose to 103° F. with a simultaneous elevation in pulse and respirations. Bilateral bronchopneumonia was diagnosed. He became rapidly worse and died on the seventh day of pneumonia, cardiac failure, and terminal pulmonary œdema.

Post-mortem examination revealed extensive bilateral bronchopneumonia of

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both lower lobes with an associated œdema of the remaining lung substance. The pathological findings in the heart and other organs exclusive of the liver were not remarkable. A moderate degree of diffuse peritoneal exudate was present.

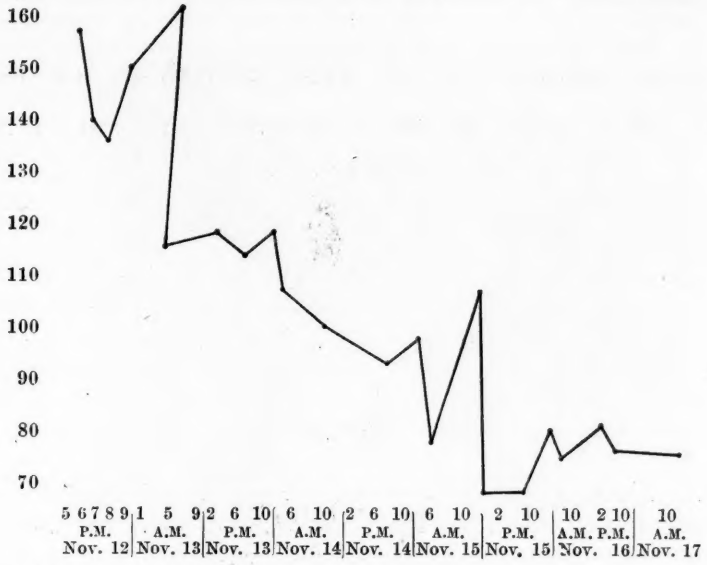

FIG. 343.—Blood-sugar estimation.

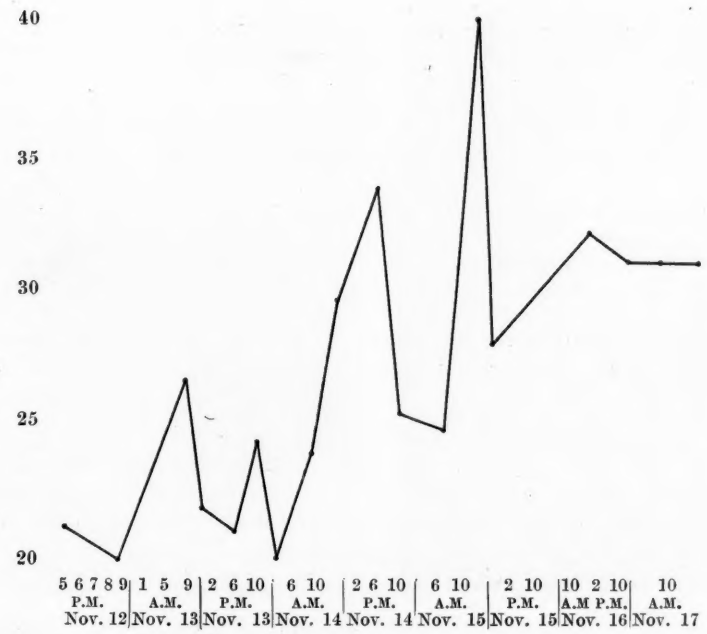

FIG. 344.—Non-protein nitrogen estimation.

The anterior and posterior aspects of both lobes of the liver were covered with several fibrinous plaques. The left lobe presented a depression on its anterodorsal surface which measured about 7·5 × 5·5 cm. This was paler in colour and softer in consistency than the surrounding liver substance. The whole left lobe appeared

softer than the right, which seemed healthy. Several irregularly-shaped pale areas were seen on the cut surface of the left lobe, the largest of which measured 4·2 by 1·7 cm. They were yellowish-white in colour; the lobular markings were indistinct and well demarcated from the remaining liver substance by a slight band of hyper-

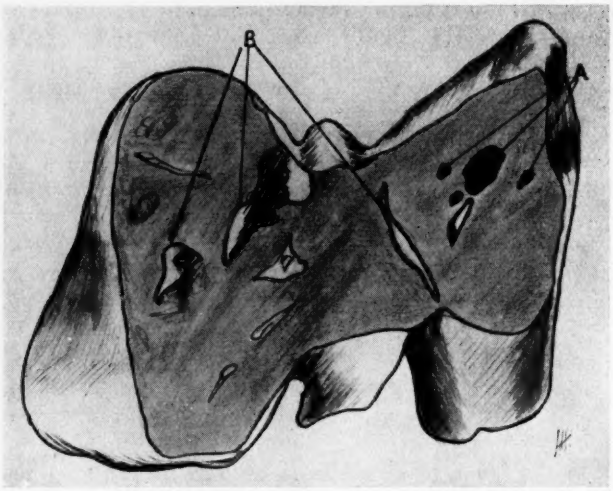

FIG. 345.—Sketch of cut surface of liver. A, Extent of necrosis in the liver; B, Normal liver vessels.

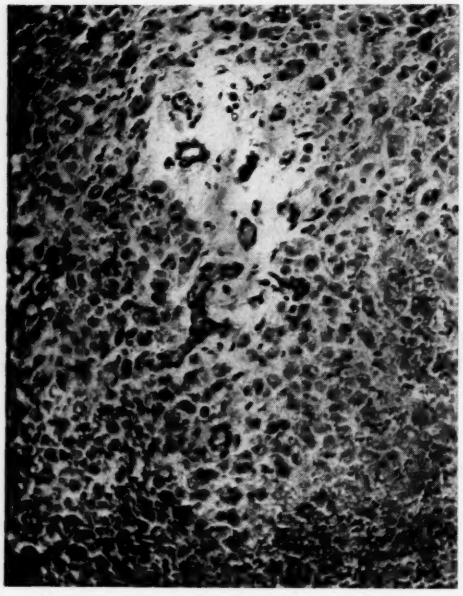

FIG. 346.—Microscopic appearance of the necrotic area.

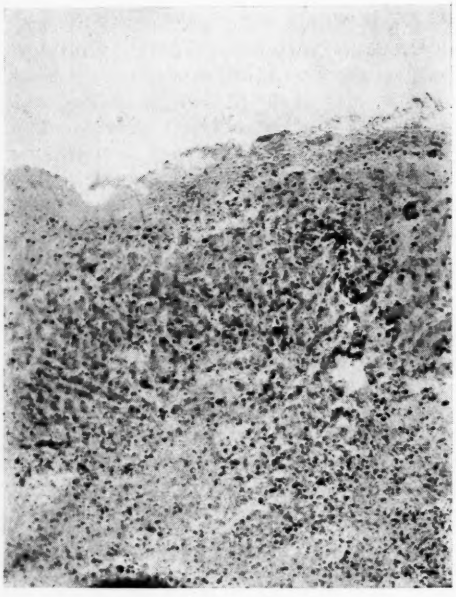

FIG. 347.—Showing the margin of the area of necrosis in the subcapsular region.

æmia. This necrosis did not involve the capsule or the liver substance immediately beneath it. (*Fig.* 345.)

Elsewhere in the lobe the liver was a dark reddish-brown colour and the lobular markings stood out well. Microscopically the appearance varied, depending upon the

area from which the section was obtained. Some showed normal liver cords with their usual well-defined arrangement. Others presented varied degrees of necrosis where only hazy outlines of hepatic architecture remained; the liver cells were jumbled together in irregular masses of pale-staining granular cytoplasm, nuclei being conspicuous by their absence (*Fig.* 346). Toward the periphery of these areas the liver cells were fragmented and pale-staining; the bile-ducts stood out prominently in comparison. Although all the liver cells undergoing necrosis were involved to a greater or lesser degree, those immediately beneath the capsule appeared slightly healthier than those in the more central zones. The capsule was thickened and an increased deposit of fibrinous material was present on its surface, in which a few small capillaries could be seen (*Fig.* 347). Minute, careful examination of the vessels showed that the only possible sources of arterial blood-supply were through the anastomoses of the phrenic arteries in the diaphragm, and possibly through a small anastomosis between the left gastric artery near the œsophagus and the left lobe of the liver. The latter seemed precarious, and it is doubtful if any arterial blood was carried to the liver from this source.

The relatively small amount of liver necrosis in this case was not sufficient to cause death. There were no clinical signs or symptoms of its existence, and no evidence to make one believe that death was due to liver insufficiency. The laboratory findings corresponded with the clinical course. The blood-sugar ranged from 0·15 to 0·08 mgrm. per 100 c.c. of blood, while the non-protein nitrogen varied from 22 to 39 mgrm. per 100 c.c. of blood. The Van den Bergh reaction was negative, and urinalysis showed a trace of albumin, moderate ketosis, and faintly positive urobilin reaction. We have reason to believe from the reports previously published that had he an otherwise uncomplicated post-operative course, our patient would have survived the damage done to his liver by ligation of the common hepatic artery.

REVIEW OF THE LITERATURE, AND DISCUSSION OF ARTERIAL BLOOD-SUPPLY TO THE LIVER.

Ligation of the hepatic artery has been reported by Socin,[1] Salzer,[2] Ritter,[3] Kehr,[4] Sprengel,[5] Tuffier,[6] Wendel,[7] Behrend,[8] Alessandri,[9] Bertram,[10] Tichow,[11] Kausch,[12] Narath,[13] Palacio-Ranam,[14] Wilms,[15] Gurbe and Herrenschmidt,[16] Von Haberer,[17] Klose,[18] Holst,[19] Bakes,[20] Smith,[21] and Hofmeister.[22] These have been divided into five groups by Ritter[3] in his excellent review of this subject—namely: (1) Ligation of arteria hepatica communis with ligation of collateral circulation; (2) Ligation of arteria hepatica propria; (3) Ligation of the right hepatic artery; (4) Ligation of the left hepatic artery; (5) Cases where point of ligation was not clear. In order that this classification may be better understood, the blood-supply to the liver is briefly reviewed as follows:—

The liver is supplied with blood from two great sources: the portal vein and the hepatic artery. The ramifications of the former and its part in the maintenance of liver viability and function do not enter into the scope of this report. Suffice it to say that there is a wealth of experimental evidence to prove that oxygenated arterial blood is essential to the maintenance of healthy liver tissue (Baruch,[23] Behrend,[8] Bainbridge and Leathes,[24] Segall,[25] Cameron and Mayes,[26] and Polettini[43]). The arterial supply to the liver is derived mainly from arteria hepatica communis, which arises from the cœliac

axis. As Segall points out in his study of the blood channels of the liver, the anastomoses of the phrenic arteries with the hepatic artery may be sufficient to carry on the circulation of the liver should the latter be occluded. We could find no direct branch of the inferior phrenic arteries which went to the liver, but the anastomoses through the diaphragm probably were sufficient. Extensive anastomoses are normally present which permit marked damage to portions of the arterial supply of stomach, liver, and spleen without impairment of their substance. From *Fig.* 348, which shows the normal collateral circulation in connection with the hepatic artery, it can be seen that the liver could be supplied satisfactorily through the left gastro-epiploic, the left gastric, and possibly through the phrenic arteries. In addition to the collateral circulation the presence of developmental anomalies which Behrend[27] found to exist in 33⅓ per cent of his cases, and the fact first enunciated by Ruysch[28] that no given artery distributes itself in exactly the same manner in any two or more cases, make deliberate, accidental, and successful ligation

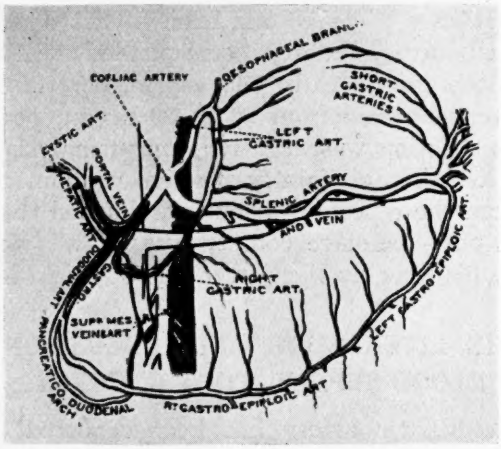

FIG. 348.—Normal arrangement of collateral circulation in connection with hepatic artery. The shaded area indicates damage in the present case. (*Cunningham.*)

of the vessel possible, as well as readily understandable. Three of the many possible anomalies are shown in *Figs.* 349–351. The course and distribution of the hepatic artery subsequent to its division into right and left hepatic arteries are well described by Segall.[25] He points out from his studies with experimental injection of human livers that the tying off of the right hepatic artery should have no effect upon the liver substance so supplied if the left hepatic were intact, and vice versa. He also notes that certain of the branches of these arteries are end arteries and their occlusion would result in infarcts. Such vessels terminate some distance beneath the capsule, and he accounts for the absence of necrosis in the capsule and immediately beneath it by the rich subscapular anastomoses.

Of the 27 cases previously reported, 15 died. A brief summary of these cases with their clinical and pathological findings will be found in the table on pp. 572–576. A large number of these have been abstracted directly from the papers of Ritter,[3] Rolland,[29] and Freedenwald and Tannenbaum.[44]

In addition to the cases reviewed, Kading[45] reported the successful ligature of the vessel by Sudeck to relieve an intra-hepatic aneurysm. Cases have been operated upon for the treatment of aneurysm of this vessel by Riedel,[30] Habs,[31] Friedman,[32] Merkel,[33] Baruch,[23] Anderson,[34] Sauerteig,[35] Niewerth,[36] and Miculicz.[46] In none of these, however, was the vessel

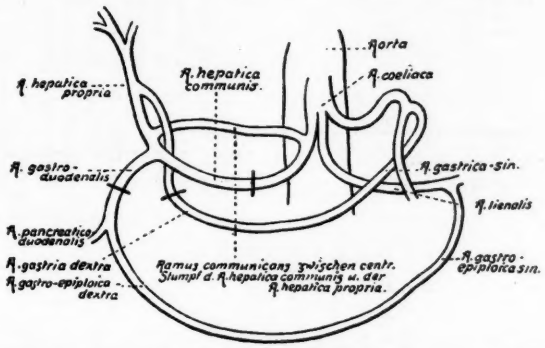

FIG. 349.—Anomalies of hepatic artery. An accessory common hepatic arising from arteria hepatica communis near its origin. (*Ritter.*)

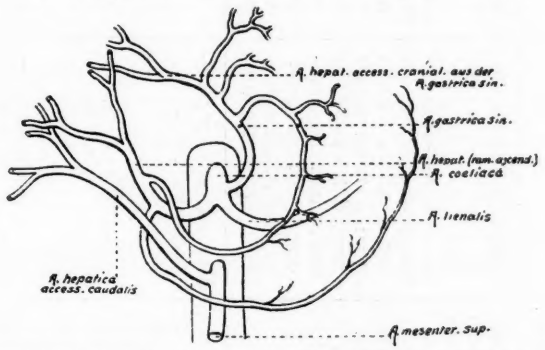

FIG. 350.—Anomalies of nepatic artery. Accessory hepatic artery arising from superior mesenteric artery. (*Ritter.*)

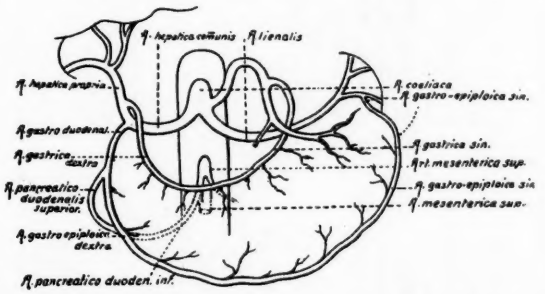

FIG. 351.—Anomalies of hepatic artery. Right gastric arising from arteria hepatic propria instead of the arteria hepatic communis. (*Ritter.*)

ligatured. Chiari,[37] Merkel,[33] and LeDieu[38] reported cases in which complete occlusion of the hepatic artery had occurred, Chiari by embolism, Merkel and LeDieu by thrombosis. There was frank liver necrosis in the first, a normal liver in the second, and cirrhosis of the liver in the third. The fact that there was no frank necrosis in the latter two cases is explained by their well-established collateral circulation.

ANALYSIS OF TWENTY-EIGHT CASES OF LIGATURE OF THE HEPATIC ARTERY

No.	Author	Vessel	Reason for Ligation	Clinical Course	Laboratory Findings	Pathological Findings	Result
1	Socin	Arteria hepatica communis	Hæmorrhage from pancreatico-duodenal in stomach resection	Death in 3 hours	None	None	Death in 3 hours
2	Salzer	Arteria hepatica communis	Ligatured by mistake during gastric resection in pyloric cancer	Death in 7 hours	None	Flabby liver. No definite liver necrosis	Death in 7 hours
3	Ritter	Arteria hepatica communis	Ligatured by mistake during difficult gastric resection for penetrating ulcer. Accessory hepatic artery found	Tired and weak for some time. Pulse and temperature normal 4th day after operation. No jaundice. No evidence of liver insufficiency. Well 10 months later	Intensive investigation 7th to 21st day revealed very little disturbance of CHO or protein metabolism. VDB very slightly positive 8th day	None	Recovery
4	Kehr	Arteria hepatica propria	Ligatured purposely for hæmorrhage in operating upon an aneurysm of right hepatic artery	Patient slightly jaundiced on 8th day		Next day liver bloodless; 1 cm. incision produced no bleeding. 10th day right border necrotic. A strip 2 cm. wide was ultimately detached from this border	Recovery
5	Sprengel	Arteria hepatica propria	Deliberate clamping of vessel in region of cœlic axis for hæmorrhage from a ruptured liver. This was released in 7 days and venous bleeding controlled by tamponade	Temperature subnormal on 10th day, deeply jaundiced, with extrusion of liver sequestra followed by pyrexia. Discharge from wound and death 20th day	None	Arteria hepatica propria torn between right gastric and gastroduodenal arteries. Two perforations of the portal vein. Multiple liver abscesses. Red infarcts	Death in 20 days
6	Kehr	Arteria hepatica propria	During an operation upon a case with stone in the common bile-duct, the stone was removed, the gall-bladder excised and the liver drained. Deliberate	Eighth day secondary hæmorrhage. Coagulum and necrotic liver tissue removed; slow healing. Four months later abscess burst through wound. Slow convalescence	None	Necrosis of liver	Recovery

ligation to control

			cised and the liver drained. Deliberate ligation to control profuse hæmorrhage from the cystic artery. Ligated prior to bifurcation	burst through wound. Slow convalescence			
7	Tuffier	Arteria hepatica propria	Ligation for aneurysm	Death in coma in 4 days. Attributed to liver insufficiency	None	Ligature close to gastroduodenal and right gastric. Liver atrophied. No necrosis	Death in 4 days
8	Wendel	Arteria hepatica propria	Ligation during resection for gastric cancer involving hepatoduodenal ligament	Death in 36 hours	None	Hæmorrhagic infarct and nearly total necrosis of liver	Death in 36 hours
9	Behrend	Arteria hepatica propria	Tied both ends of arteria hepatica propria for hæmorrhage following severance of artery in an accident	Normal course for 10 days. Jaundiced on 11th day. Progressive emaciation; vomited occasionally and died on 14th day apparently of liver insufficiency	None	None	Death in 14 days
10	Hofmeister	Arteria hepatica propria	Tied accidentally during gastric resection	Out of bed on 2nd day. Discharged 17 days after operation. Normal post-operative course. No elevation of temperature beyond 38° C.	None	None	Recovery
11	Alessandri	Right hepatic artery	Accidental injury necessitating ligature	Severe circulatory damage made evident by functional disturbance and copious discharge for months	None	None	Recovery
12	Bertrand	Right hepatic artery	Accidental ligation during cholecystectomy for cholelithiasis followed by hæmorrhage with application of clamp to vessel	Bleeding ceased at once. Right lobe looked anæmic. Liver looked normal on the eighth day. Clamp removed on fourth day. Course uneventful. Bile secretion ceased from wound in 7 days	None	Anæmic lobe appearing normal in four days	Recovery

Continued on next page

ANALYSIS OF TWENTY-EIGHT CASES OF LIGATURE OF THE HEPATIC ARTERY—*continued*

No.	Author	Vessel	Cause for Ligation	Clinical Course	Laboratory Findings	Pathological Findings	Result
13	Tichau	Right hepatic artery	Not given	Death in 3 days. No sign or symptom described	None	Liver necrosis is extending to within 3 cm. of the fissure between the lobes	Death in 3 days
14	Wendel	Right hepatic at point beyond the cystic artery	Preparatory ligation prior to resection of the right lobe for removal of an adenoma	Healing without biliary fistula after resection of the lobe. Death 8 years later. No P.M. reports	None	None	Recovery
15	Kausch	Right hepatic at point beyond the cystic artery	No ligation. Thrombosis following too extensive cauterization during a cholecystectomy	Death resulted. Cause not given	None	Very slight liver necrosis	Death
16	Ritter	Right hepatic at point beyond the cystic artery	Ligated during a cholecystectomy in freeing the neck of the gall-bladder and ligating the cystic duct and artery. The right hepatic was here a branch of the cystic and came off unusually close to the liver.	Normal. Afebrile on 4th day. Pulse 80. Tired and weak for a long time. Home on 25th day. Appetite good. No gain in weight. Seen again 9 months later in good health	Liver function tests 7–21 days. Disturbed CHO and protein metabolism. Amino-acids elevated. Galactosuria present when given per os. Urine: albumin trace, sugar trace. Acetonuria 7th and 8th days. Urobilin slightly positive throughout. Van den Bergh negative. Benzaldehyde: trace Indican test always positive	No findings. Disturbed CHO metabolism and high amino-acid contents taken as indication of liver necrosis and functional disturbance	Recovery
17	Ritter	Right hepatic at point beyond the cystic artery	Ligatured by accident during a gastric resection for carcinoma in attempting to extirpate the lymphatic glands	Normal post-operative course until 6th day, except continuous weakness and mild bronchitis. Suddenly temperature 40° with chill and weakness the next	None	Purulent localized peritonitis in epigastrium. Jaundice. Necrosis of right lobe of liver with anomaly of the hepatic artery and ligature of the right branch	Death in 5 days

			to extirpate the lymphatic glands	mild bronchitis. Suddenly temperature 40° with chill and weakness the next day. This continued with high fever, pain in R.U.Q., resistance and rigidity below right costal margin. No jaundice. Sudden shortness of breath with rapid pulse and death on 12th day. Deeply jaundiced just prior to death		of liver with anomaly of the hepatic artery and ligature of the right branch	
18	Hofmeister	Right hepatic artery	Tied deliberately in order to resect right lobe	Small gall-bladder fistula 5 weeks later with cachexia and no sign of liver damage	None	None	Death in 5 weeks
19		Left hepatic artery	Injured during resection of stomach	Death in 7 days. Clinical course not described	None	Extensive necrosis of left lobe and lobe of of Spigeli, with localized epigastric peritonitis	Death in 7 days
20	Palacia-Ranam	Left hepatic artery	Ligated as a preparatory measure to resection of lobe for removal of gummata	Healing following resection by means of tamponade	None	The amount resected is not clearly stated	Recovery
21	Wilms	Left hepatic artery	Ligatured accidentally during gastric resection	Sudden death 15 days post-operatively from secondary hæmorrhage	None	Extensive necrosis of left lobe with perforation of the hepatic artery or one of its branches immediately beyond the bifurcation. It is suggested that bleeding was due to ulceration of the vessel following its ligation	Death in 16 days
22	Grube and Herrenschmidt	Left hepatic artery	Ligatured during extirpation of hydatid cyst in lobus quadratus	Death in 4 days of liver insufficiency	None	Total necrosis of left lobe	Death in 4 days
23	Von Haberer	Left hepatic artery	Ligatured in resecting the left lobe to remove hydatid cyst	Uncomplicated healing	None	None	Recovery

Continued on next page

ANALYSIS OF TWENTY-EIGHT CASES OF LIGATURE OF THE HEPATIC ARTERY—*continued*

No.	Author	Vessel	Cause for Ligation	Clinical Course	Laboratory Findings	Pathological Findings	Result
24	Klose	Left hepatic artery	Ligatured in resecting the left lobe for primary carcinoma	Death in 4 days with high fever and rapid pulse—cause given as endocarditis	None	None	Death in 4 days
25	Holst	Left hepatic artery	Ligatured accidentally during a gastric resection for carcinoma of stomach. It was mistaken for the gastroduodenal artery as it ran into a mass of adhesions and was retracted in an abnormal manner	Post-operative course normal until the patient suddenly began to grow weak and died 8½ days after operation: never jaundiced. Death attributed to liver insufficiency	Normal amino-acids and ammonia in the urine	Left lobe small and soft with areas of necrosis in it. Right lobe's normal appearance attributed to a small vessel in the ligamentum teres	Death in 8½ days
26	Graham and Cannell	Arteria hepatica communis	Accidental ligation in resecting carcinoma of pylorus. A large mass about pylorus explained failure to identify vessel	Uncomplicated for 4 days. On evening of 4th day bilateral bronchopneumonia, and died 7th day of pneumonia, pulmonary œdema, and cardiac failure	Faint urobilin in urine. Normal Van den Bergh. Normal blood-sugar. Normal N.P.N. in blood	Depression on left lobe of antero-dorsal aspect 7·5 × 5·5 cm. Irregular areas of necrosis on cut surface. Necrosis did not involve capsule	Death in 7 days
27	Bakes	?	During cholecystectomy forced ligation of arteria hepatica propria or one of its branches owing to hæmorrhage	Uncomplicated post-operative course during 14 days' observation	None	None	Recovery
28	Smith	?	On removing a stone from the common duct there was an alarming hæmorrhage, to control which he ligated the hepatic artery	Jaundice for 10 days, followed by rapid disappearance. Parietal sepsis developed and ventral hernia resulted; 6 months later recurrence was treated medically	None	None	Recovery

From a study of these cases and our own, it is evident that ligature of the hepatic artery in any part of its course may be followed by serious results. It may, on the other hand, be looked upon in certain instances with less anxiety than has hitherto been the case. The results of sudden ligation of the vessel where no previous impairment in its circulation has been present must in most instances be followed by liver necrosis. The degree of necrosis and the ultimate recovery of the patient depends upon the point where the ligation has been done and the condition of the collateral circulation. This study tends to confirm the findings of Von Haberer,[17] Kohle,[39] and Narath[13] that :—

1. Ligation of arteria hepatica communis can be undertaken without fear of impairment of hepatic nutrition (Merkel,[33] LeDieu[38]).

2. Ligation of arteria hepatica propria before the right gastric is given off usually results in no ill effects (Chiara,[37] Sprengel[5]).

3. Ligation beyond this point is attended with total or severe necrosis where the artery has previously been healthy. The existence of previous arterial disease, anomalies, and the establishment of efficient collateral circulation make the latter ligation possible.

The findings of almost constant necrosis in ligations of the peripheral right or left hepatic arteries make one doubt the feasibility of applying the inference from Segall's[25] injection experiment to the living subject. However, in our own case we feel that the source of supply must have been through the phrenic arteries and their diaphragmatic anastomosis which he demonstrated so beautifully.

Likewise the clinical and laboratory findings in man tend to show marked variations from ligations and experiments carried out on animals by Behrend,[8] Behrend, Radasch and Kershner,[40] Collens, Shelling, and Byron,[41] Bainbridge and Leathes,[24] and Cameron and Mayes.[26] These are due in part to the relatively richer and more widespread blood-supply in the animals, and to the fact that experimental investigation on other animals can never be applied *in toto* to man.

It is interesting to note that we suspected no evidence of liver necrosis from our study of blood-sugar and non-protein nitrogen values. This may be accounted for by the relatively small necrosis which occurred, and by the shortness of the period over which we were able to make our observations. The latter view is in part confirmed by the findings in Ritter's[3] cases, where changes in carbohydrate and protein metabolism were found only after the condition had been present for some days. One may point out, however, that in the cases presented where laboratory studies are available, the patients did not exhibit any evidence of hypoglycæmia. In those where a fatal outcome ensued, no evidence is submitted which points to hypoglycæmia as a predominant factor in this event. Thus again the clinical findings in man do not correspond entirely with the experimental evidence obtained in animals by Mann and Magath[42] and Collens et al,[41] where death in coma resulted in a short time from exhaustion of glycogen supplies in the body. Ritter[3] found, however, in his second case that disturbances of carbohydrate metabolism did occur, as well as a marked rise in the amino-acid content of urine. These findings are borne out experimentally by Mann and Magath[42]

in their investigations of liver function. Ritter[3] believed that any increase in amino-acids greater than four to five times the normal values, in conjunction with a serious clinical picture, was justification for re-operation and resection of the affected portions. That this procedure is justifiable, or would be successful in any instance, has yet to be proved. The absence of jaundice in many cases is surprising and interesting; for the most part its intensity corresponds with the extent of the liver necrosis. Death resulted in 16 of the 28 cases in which the hepatic artery or its branches have been ligated. The part played by the resulting liver necrosis in these deaths is not easily determined. For the most part they occurred in patients suffering from other diseases, and frequently accompanied extensive intra-abdominal operations. In at least 7 cases death was attributed to liver insufficiency. However, the extensive liver necroses which may occur without fatalities encourage one, should ligation of the artery become necessary or occur accidentally during an operation.

CONCLUSIONS.

1. A case of ligation of the hepatic artery is here reported, together with a review of 27 cases previously reported.

2. Ligation of the hepatic artery is always a serious, but not necessarily a fatal, accident.

3. The prospect of liver necrosis increases steadily as the point of ligature moves toward the periphery.

4. The extent of necrosis and the absence of clinical and laboratory evidence of its existence in our case is remarkable.

5. The rather delayed development of liver insufficiency in man contrasts sharply with the findings in experimental animals, and make successful operative interference a possibility.

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THE PATHS OF GALL-BLADDER INFECTION: AN EXPERIMENTAL STUDY.*

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INTRODUCTION.

Much work has been done in an attempt to prove the source of infection found in cholecystitis and gall-stones, though the exact relation of the infection to gall-stone formation is still in dispute. But though it is generally accepted that an intramural focus is the commonest starting-point of the actual gall-bladder inflammation there is by no means the same agreement as to the origin of the causative bacteria. Rosenow (1916) and Wilkie (1927) have done much to prove the frequency of intramural infection and are mainly responsible also for the hypothesis of 'elective localization'; they suggest a bacterial embolus of peripheral origin and lay stress on the specificity of certain streptococci. Many authorities would exclude the intestinal bacteria as possible primary causative agents and regard them merely as secondary invaders. Gordon-Taylor and Whitby (1930, 1932), in a series of routine examinations, as well as in a review of the literature, have clearly shown that intestinal bacteria are those most commonly found in human cholecystitis—a view which has been confirmed by Williams and McLachlan (1930) and which was universally believed prior to the work of Rosenow and Wilkie. It may also be emphasized that Williams and McLachlan ascribe an intestinal origin to the majority of strains of streptococci isolated by them from the biliary apparatus. By inference, therefore, one is justified in believing in the intestinal origin of the majority of embolic foci in the gall-bladder, and even if the intestinal bacteria are dismissed as mere secondary invaders one is still faced with the problem of detecting by what route these organisms have reached the gall-bladder.

Many writers assume that the liver is an efficient bacterial filter and that organisms arriving in the liver from the portal circulation are promptly trapped and destroyed or excreted in the bile. Our experiments, though primarily designed to determine the route of infection in gall-bladder disease, also provide some evidence on the filtration power of the liver. We have set out to contrast the fate of bacteria injected into the portal and systemic circulation respectively. We have been concerned also with the fate of other substances such as Indian ink and emulsions of malignant tumours when similarly injected. From these experiments conclusions are drawn as to the probable route of infection in experimental cholecystitis.

* From the Bland-Sutton Institute of Pathology.

METHOD OF INVESTIGATION.

The general plan of the investigation was to make cultures of the blood, bile, gall-bladder wall, liver, and other organs of rabbits after injection of organisms by various routes. The cultures were afterwards made at intervals varying from a few minutes to several weeks. The standard dose injected was 0·5 c.c. of an overnight meat broth culture of *B. welchii*. The same strain was used throughout the whole series. *B. welchii* was chosen partly because its presence in human gall-bladder infections had already been studied (Whitby and Gould, Whitby and Gordon-Taylor) and partly because of the ease with which it may be recognized in culture. During the course of the investigation, however, another advantage of the *B. welchii* became apparent—namely, the relative resistance of the rabbit to the organism. As the result of this resistance most of the animals could be allowed to survive until the experiment was concluded without obvious ill effects developing, thus allowing investigation of the routes traversed by the organism without involving the complicating factor of gross inflammatory changes.

For the intra-portal injections, the abdomen was opened under ether anæsthesia through a middle-line incision and the injection made into one of the veins in the mesentery of the small intestine; leakage was prevented by ligaturing the vessel on either side as the needle was being withdrawn. Systemic injections were made into one of the ear veins. The blood was taken for culture from the ear veins and in a few cases from the heart. The tissues were taken for culture immediately after the animals had been killed by chloroform inhalation. The abdominal wound was reopened with the cautery, and the bile aspirated with a very fine needle through a small cauterized spot on the gall-bladder wall. If the bile was blood-stained, which only rarely occurred, indicating either a puncture of the liver or a laceration of the gall-bladder wall, the specimen was rejected. Of the gall-bladder, a portion of the free surface was taken for culture, carefully avoiding all tissue adherent to the liver. All cultures were made into meat broth medium and were examined twenty-four and forty-eight hours afterwards.

Results of Intra-portal Inoculations.—These are shown in *Table I*. Each rabbit received 0·5 c.c. of an overnight meat broth culture of *B. welchii* into a mesenteric vein.

Gall-bladder Wall.—Organisms were grown from the gall-bladder wall in all the 17 cases cultured within thirty minutes of the intra-portal inoculation. At the end of twenty-four hours a few negative cultures began to appear, and by the end of a week slightly less than half were positive.

Bile.—Only 2 out of the 17 biles cultured within thirty minutes of the inoculation were positive. The incidence of biliary infections rose to a peak at forty-eight hours (9 cases out of 26).

Liver.—The liver, as might be expected from its anatomical position and its relation to the reticulo-endothelial system, was the most constantly infected organ of those examined. In all the 29 cases cultured within forty-eight hours the liver was positive, and by the end of a week the incidence of positive cultures had only dropped slightly (8 out of 9).

Blood.—All cultures of systemic blood made within the first thirty minutes

after intra-portal inoculation were positive. At twenty-four hours also most of the cultures were positive. But by forty-eight hours the number of positive cultures had fallen to 3 out of 15, and by the end of a week to only 1 out of 8.

Table I.—Results of Intra-portal Inoculations.

No. of Animals	Time after Inoculation	Positive Cultures from				
		Gall-bladder	Bile	Liver	Blood	Kidney
8	Immediate ..	8/8	1/8	8/8	8/8	—
9	10–30 mins. ..	9/9	1/9	9/9	9/9	—
15	24 hours ..	13/15	3/15	—	4/5	—
26	48 hours ..	20/26	9/26	12/12	3/15	3/3
9	1 week	4/9	2/9	8/9	1/9	6/9
3	5 weeks ..	1/3	1/3	1/3	0/3	—
70		55/70 (78%)	17/70 (24%)	38/41 (92%)	25/49 (51%)	9/12 (75%)

Note.—Figures for positive cultures: Numerator = Positive results. Denominator = Cultures made.

Summary.—The experiments show that immediately after intra-portal inoculation organisms can be cultured from the liver, gall-bladder, and systemic blood. The bile, however, does not become infected with any frequency until forty-eight hours later, and then only in a minority of cases. By the end of a week the organisms have disappeared from the blood and are beginning to disappear from the gall-bladder, but are almost invariably still present in the liver, where they may remain many weeks or even months (in one case the liver still contained the organism nine weeks after inoculation).

Results of Systemic Inoculations.—These are shown in *Table II*. Each rabbit received 0·5 c.c. of an overnight meat broth culture of *B. welchii* into the aural vein.

Table II.—Results of Systemic Inoculations.

No. of Animals	Time after Inoculations	Positive Cultures from				
		Gall-bladder	Bile	Liver	Blood	Kidney
4	10–30 mins. ..	3/4	0/4	4/4	—	—
6	24 hours ..	4/6	1/6	4/6	6/6	3/6
12	48 hours ..	6/12	4/11	11/12	6/12	5/12
1	9 days	0/1	0/1	—	—	—
1	19 days ..	0/1	0/1	—	—	—
3	5 weeks ..	0/3	0/3	0/3	—	—
27		13/27 (48%)	5/26 (19%)	20/25 (80%)	12/18 (66%)	8/18 (44%)

Table II shows that the time distribution of positive cultures in the tissues and organs examined after systemic inoculation is approximately the same as after intra-portal inoculation. There is, however, a fall in the total

incidence of infections in the gall-bladder and kidney. Thus one concludes that infection by the portal route is at any rate as easy as by the systemic.

Results of Intra-portal Inoculation with Diluted Doses.—In the experiments so far described the number of bacilli injected has been large, the organism content being of the order of 500 million per cubic centimetre. A series of experiments was next performed in which progressive dilutions of the standard were injected intra-portally varying from 25 million bacteria to 25. The results of culture of the systemic blood, liver, and gall-bladder of these cases five minutes after inoculation are given in *Table III.*

Table III.—Quantitative Intra-portal Inoculation. Cultures Five Minutes after Inoculation.

No. of *B. welchii* Injected	Cultures from		
	Blood	Liver	Gall-bladder
25 million	+	+	+
2½ million ..	+	+	+
250,000	+	+	0
25,000	+	+	0
2500	+	+	0
250	+	+	0
25	+	+	0

It can be seen that in all dilutions the organism could be recovered from the systemic blood five minutes after the intra-portal inoculation. Even for small numbers, therefore, the liver is not an efficient filter and does not prevent the entry of some organisms into the systemic circulation. It will also be seen that with injections of 250,000 organisms or less, though the organisms reached the general circulation, the gall-bladder was sterile. The healthy rabbit's gall-bladder thus shows no special tendency to take up the *B. welchii* from the circulating blood when the numbers are small.

An attempt was next made to repeat some of the earlier experiments with smaller doses of organisms, and 8 rabbits were injected with a dilution of the original broth culture containing 2500 organisms per 0·5 c.c. The rabbit is, however, as has already been noted, so resistant to the *B. welchii* that at the end of forty-eight hours only 2 of the livers were found to contain the organism and none of the other tissues and organs examined (blood, bile, kidney, gall-bladder) were positive. In these circumstances experiments with the smaller dilutions were not continued.

DISCUSSION.

We will discuss these results as well as certain other experimental evidence in relation to the results of other workers and in relation to the theoretically possible routes of gall-bladder infection, namely: (1) By blood-stream infection—systemic or portal in origin; (2) By lymphatic infection—from the liver or some other organ; (3) By way of the biliary passages—downwards

from the liver or upwards from the duodenum; (4) By direct spread from an abdominal viscus.

1. **By Blood-stream Infection.**—This is generally believed to be the most likely route of infection of the gall-bladder, strong evidence in its favour being the frequency with which, in cases of cholelithiasis, the gall-bladder wall is infected while the gall-stones and fluid contents are sterile. In our experiments, organisms could invariably be detected in the systemic blood shortly after intra-portal inoculation even when the dose injected was small. With the larger doses, the gall-bladder was constantly infected in the early stages when the bile was sterile, so that, leaving aside for the moment the question of lymphatic infection which we will discuss later, spread of organisms to the systemic circulation and thence through the cystic artery would appear to be the easiest route for infection to reach the gall-bladder even after intra-portal inoculation. Because the cystic artery is a probable route of infection of the gall-bladder, the inference is frequently made that some systemic focus of sepsis such as the teeth or tonsils is necessarily the source of the organisms. This view is expressed by Nickel and Judd (1930) and by Ogilvie (1929) and is clearly formulated by Illingworth and Dick (1932), who in their recent text-book state: "Organisms may reach the gall-bladder directly from the systemic blood-stream from some distant infective focus. This avenue of infection is the one most widely accepted at the present time although it is backed by no strong clinical support. On this view, septic foci in the teeth, tonsil or other regions provide the source of infection and it is usually believed that the organisms principally responsible are streptococci." The present experiments, however, show that the liver, like the lung, is quite inefficient as a bacterial filter and we would stress that experimental gall-bladder lesions produced by systemic inoculations could quite as easily have been produced as the result of intra-portal inoculation. Experiments with systemic inoculation thus prove nothing in the way of excluding the bowel as the origin of a bacterial embolus.

The intestinal nature of the majority of organisms found in relation to gall-stones has already been noted, and the possibility of organisms entering the portal circulation from the bowel is generally admitted, though the factors involved appear to be complex (Arnold, 1929). If it is admitted that intestinal organisms may pass out from the bowel, they may then readily traverse the portal circulation and liver to the general circulation, and one has to consider why they should lodge in the gall-bladder. In the present experiments when large doses were injected the gall-bladder in the early stages almost regularly contained the organisms, which probably had formed capillary emboli. In our experiments with the smaller doses, which approximate more to the conditions likely to obtain in man, the gall-bladder was sterile. One explanation of lodgement in the gall-bladder is the assumption of a specific affinity for the gall-bladder on the part of some organisms, as has been claimed for certain streptococci by Rosenow and Wilkie, though this has been denied by others (McLachlan and Williams) and is now being investigated by ourselves. Or, as an alternative explanation, it may be suggested that the gall-bladder at the time that the organisms are circulating happens to be in a state of lowered resistance which allows of their lodging.

If the view is taken that gall-stones are primarily aseptic and metabolic in origin, then the stones themselves may be responsible for the lowering of the resistance of the gall-bladder which allows of bacterial lodgement. If on the other hand biliary calculi result from the presence of bacteria in the gall-bladder wall, then some factor such as stasis or congestion has to be postulated to explain their lodgement in the first instance.

2. By Lymphatic Infection from the Liver.—The importance of infection of the gall-bladder from the liver through the lymphatics has been strongly urged by Graham (1929). Anatomically the natural direction of lymph-flow is from the gall-bladder to the portal fissure. There is no recognized route of lymph-flow from the liver to the gall-bladder. Thus on theoretical grounds a spread of bacteria from the liver to the gall-bladder would necessitate a reversal of the normal direction of lymph-flow. Our experiments show that the liver is much the most frequently infected organ at all times after inoculation. If therefore there were free lymphatic communication between the liver and the gall-bladder, one would expect the gall-bladder to contain the organism much more frequently than some other organ, such as the kidney, which did not possess this intimate lymphatic relationship. But the gall-bladder was not more frequently infected than the kidney, and, in fact, at the end of a week after intra-portal inoculation when organisms are beginning to disappear from most of the organs examined except the liver, the kidney was more frequently infected than the gall-bladder. So that the experiments so far as they go do not provide support for the lymphatic route of infection.

In an attempt to obtain further evidence on this point a number of rabbits were injected intra-portally with organisms after the gall-bladder had been separated from the liver and any direct lymphatic communications presumably divided. This, however, proved to be an unsatisfactory type of experiment from the technical standpoint owing to the changes produced in the gall-bladder through the injury necessarily inflicted and owing to the inflammatory reaction and adhesions produced around. Two different lines of experiment were therefore followed in an endeavour to obtain collateral evidence on this question of a possible lymphatic route of infection from the liver to the gall-bladder. Firstly, it is well known that Indian ink injected interstitially finds its way to the regional lymphatic glands (Cappell, 1929). Several experiments were therefore performed in which Indian ink was made to reach the liver in various ways, either by injection into the systemic or portal circulations, or by direct inoculation of the liver in the neighbourhood of the gall-bladder. After several days the animals were killed and microscopical sections made to include the gall-bladder and liver. In no case was there evidence of spread from the liver to the gall-bladder, though in all cases many cells filled with ink could be seen close under the capsule of the liver. A further series of experiments was performed in which Indian ink was injected as before, but in which in addition the gall-bladder was injured in various ways so as to produce an inflammatory reaction. But in these, too, there was no sign of spread of the ink from the liver to the gall-bladder.

The other way in which the intimacy of the lymphatic relations of the liver and gall-bladder was investigated was by the injection of tumour

emulsions. The Brown-Pearce transplantable carcinomatous tumour of rabbits is well recognized as spreading extensively by the lymphatics as well as by direct spread and by the blood-stream. By the injection of dilute tumour emulsions into the portal system with the same technique as was used for the *B. welchii* cultures, deposits of carcinoma were produced in the liver in several rabbits. And although these deposits were often widely spread throughout the liver, including that part of the liver most closely related to the gall-bladder, in no case were any deposits of growth present in the gall-bladder as would be expected if there were a free and active lymphatic connection between the two organs. These experimental findings with tumour emulsions merely serve to confirm a common observation in the post-mortem room, that even in advanced cases of secondary carcinomatous deposits in the liver the gall-bladder is extremely rarely involved—an observation that apparently also applies to primary malignant disease of the liver (Tull, 1932).

In face of such formidable negative evidence, therefore, the positive evidence that the lymphatic route from the liver to the gall-bladder is an important avenue of infection in human cases of cholecystitis and gall-stones requires to be strong. Graham's evidence consists largely in the demonstration of collections of inflammatory cells in the liver particularly around the intrahepatic biliary ducts. This 'pericholangitis', he thinks, may indicate an infection of the periductal lymphatics. But in rabbits at any rate this 'pericholangitis' is almost the rule, and in human livers, too, Flint has shown that it can very frequently be found even when there is no obvious evidence of disease of the biliary passages. It would appear, therefore, that Graham's evidence is not sufficiently strong and that his interpretations are capable of reversal—namely, that the cholecystitis precedes the hepatitis, especially since the hepatitis is more marked the nearer one gets to the gall-bladder (Wilkie[2]). In the absence, therefore, of strong positive evidence, the lymphatic route of infection from the liver to the gall-bladder cannot at present be regarded as important.

3. By Way of the Biliary Passages.—

a. Downwards from the Liver.—Our own results show that the injection of relatively large doses of bacteria, whether into the systemic or portal circulations, leads to excretion in the bile in approximately 25 per cent of cases. With smaller doses the incidence would probably be less. The excretion does not begin immediately but is quite definite at the end of twenty-four hours and is maximal in about forty-eight hours. The same result was obtained by Meyer (1921) using *B. typhosus*. We consider that our results give a true estimate of the amount of biliary excretion, for in that we used a relatively avirulent organism—*B. welchii*—with which there were no associated gross inflammatory gall-bladder changes, we were able to avoid the complicating factor of inflammation. With a highly virulent organism the gall-bladder wall may become inflamed and organisms be discharged from the inflammatory focus into the bile. Our results thus confirm those of Sherrington (1893). From these results one can only deduce that one of the methods by which the liver rids itself of bacteria is by excretion in the bile, and it is rational to assume that the bigger the implanted dose the more

constant is biliary excretion. One cannot therefore exclude biliary excretion as a possible route of infection.

b. Ascending from the Duodenum.—In that there is a natural open channel from the duodenum to the gall-bladder it was at one time supposed that this route would be a common one. This would be especially so when achlorhydria permits a heavy duodenal bacterial flora. The chief argument against this route is the frequency with which the contents of the gall-bladder are sterile when the walls are infected. But actual experimental evidence is scanty, and Meyer, who considered in great detail the other possible routes of infection, dismisses ascending infection from the duodenum very briefly and merely states that organisms introduced into the duodenum of rabbits could not be recovered from the bile.

The term 'ascending infection' is used in three ways. First it is used to describe a progressive infection of a duct system by contiguity of inflammation. For example, in some cases of inflammation of the female genital tract there may be successively a vulvo-vaginitis, cervicitis, endometritis, salpingitis, and finally pelvic peritonitis. From the absence of symptoms of duct inflammation in an ordinary case of gall-stones, however, it is unlikely that a similar sequence of events is common in the biliary passages. Secondly, some cases of apparent spread by contiguity of inflammation are believed to be examples of spread by periductal lymphatics, e.g., tuberculosis of the male genital tract. What is often understood, however, when ascending infection of the biliary passages is referred to is an infection from the duodenum along the lumen of the common bile-duct against the main biliary stream. By analogy with the urinary tract, the principal factor which would predispose to this would be some form of obstruction which damages the normal valvular mechanism of the duct opening and also creates a stagnant column of fluid in the duct system. An attempt was therefore made to reproduce these conditions experimentally in rabbits by partially occluding the duodenum a short distance below the entrance of the common bile-duct and injecting into the lumen of the bowel above the obstruction a culture of *B. welchii*. This was done in 6 animals, which were killed forty-eight hours later, and cultures immediately made of the bile, gall-bladder, and liver. In all cases there was considerable dilatation of the stomach and duodenum above the obstruction. The results of this experiment are given in *Table IV*.

Table IV.—Cultures from Rabbits Inoculated with *B. welchii* into the Lumen of the Duodenum.

Rabbit	No. of Organisms Injected	Liver	Gall-bladder	Bile
1	500 million..	+	+	+
2	,, ,, ..	+	+	0
3	,, ,, ..	+	+	0
4	250 ,, ..	+	0	0
5	,, ,, ..	0	0	0
6	,, ,, ..	0	0	0
	Totals ..	4	3	1

It will be seen that of the 6 cases in only 1 was the bile infected with *B. welchii*, whilst the gall-bladder wall was in 3 and the liver in 4. In these experiments, in view of the sterility of the bile, an ascending infection in the bile can be excluded. And while the possibility of infection through the periductal lymphatics cannot be dismissed, from the previous experiments it seems likely that the gall-bladder and liver were infected through the blood-stream. These experiments therefore support the view that ascending infection from the duodenum along the lumen of the bile-duct must be a rare occurrence.

4. **Direct Infection from Neighbouring Viscera.**—Cases have occasionally been reported in which infection of the gall-bladder has occurred from an inflamed organ in the neighbourhood. For example, Rutherford (1930) has reported a case of cholecystitis secondary to a highly placed inflamed appendix. But these cases are chiefly reported as curiosities, and there is no evidence that organisms can spread in a similar way from non-inflamed viscera, so that this route need not be considered further.

CONCLUSIONS AND SUMMARY.

As the result of our experiments we have concluded that the cystic artery is the easiest route by which organisms can reach the gall-bladder even after intra-portal inoculation. We have already noted that the relative frequency with which in cases of human gall-bladder disease the gall-bladder wall is infected while the contents are sterile is generally believed to point to the cystic artery as the route of infection. Our experiments show that it is not a necessary inference from this that some systemic focus such as the teeth or tonsil is the source of the gall-bladder infection, as is sometimes asserted, and that the intestine affords just as likely a source. If in addition the well-recognized frequency of intestinal organisms in biliary infections is taken into account, it must be concluded that the intestine plays the predominant rôle in these infections. There is, however, one difficulty in the way of the acceptance of the blood-borne route of infection in human gall-bladder disease, and that is to explain why organisms should lodge particularly in the gall-bladder. The gall-bladder is not an organ like the spleen actively engaged in the taking up of organisms from the blood-stream. One explanation is the elective localization theory of Rosenow, which postulates a selective affinity on the part of certain organisms, particularly some strains of streptococci, for the gall-bladder. This theory, however, has been strongly criticized (Williams and McLachlan). Otherwise one is left with the explanation that the gall-bladder is in a lowered state of resistance when the organisms are circulating. In this connection it is interesting to note that Andrews and Hrdina (1931) found after ligature of the cystic or common bile-ducts in dogs that an infection with intestinal organisms usually followed, though they attributed it to a lymphatic infection.

The only other route we consider worthy of serious consideration is that of excretion from the liver in the bile. Infection of the bile was present in 25 per cent of our experiments, though there is a latent period of some forty-eight hours before it becomes at all frequent. Excretion in the bile is presumably one of the ways by which the liver rids itself of organisms, though there is some difference of opinion on whether the undamaged liver can allow

organisms to pass. Sherrington (1893) was of the opinion that damage to the liver cells had first to take place, but in our experiments organisms of a very low degree of virulence to the rabbit were excreted in this way. The biliary route would explain on an anatomical basis the special frequency of intestinal organisms in gall-stones, and would also fit in with the fact that the organisms commonly found are relatively bile-resisting, e.g., *B. coli*, *B. welchii*, *B. typhosus*, *Streptococcus fæcalis*. So that arbitrarily to dismiss this route as a possible path of infection, as is sometimes done, is not justifiable. The great objection to it, however, as we have already noted, is the relative frequency of infected gall-bladder with sterile bile, though this is more so in chronic cases than acute and in the former it is conceivable that the biliary infection has died out.

We may therefore summarize our findings and conclusions as follows :—

1. Experimentally, the cystic artery is the easiest route by which organisms can reach the gall-bladder.

2. The liver is not an efficient bacterial filter. Bacterial emboli may therefore reach the gall-bladder as easily from a portal focus as from a systemic one.

3. There is no evidence that lymphatic spread from the liver to the gall-bladder is a probable route of infection.

4. The possibility of infection of the gall-bladder by bile descending from the liver cannot be dismissed. Ascending infection by the biliary lumen from the duodenum is, however, probably extremely rare.

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ACUTE INFECTIVE OSTEOMYELITIS.
A REVIEW OF 262 CASES.

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The series of cases reported here consists of all the cases of acute infective osteomyelitis which have been admitted to the surgical wards of the General Infirmary at Leeds during the ten-year period 1921 to 1930 inclusive. During this decade the number of surgical beds available has been constant, viz., 203, and the series of cases reported covers the work of all the surgical staff. In all, 262 cases are recorded, and of these 191 recovered and 71 died, giving a mortality of 27·1 per cent.

ETIOLOGY.

Yearly Incidence.—Although acute infective osteomyelitis is regarded throughout the country as a disappearing disease, the yearly incidence in this series is fairly constant, and there has been no real diminution in the number of cases (*Table I*). The area from which cases are drawn comprises a large part of the West Riding of Yorkshire, and includes rural localities, colliery villages, and both suburban and slum portions of the city of Leeds.

Table I.—Yearly Incidence of Acute Osteomyelitis.

Year	Males	Females	Total
1921	10	4	14
1922	10	4	14
1923	28	7	35
1924	15	10	25
1925	12	13	25
1926	20	6	26
1927	23	9	32
1928	32	11	43
1929	15	10	25
1930	14	9	23
Total	179	83	262

Sex.—This series shows more than twice as many cases in males as in females, a proportion which agrees with that reported by Platt[1] in his series of 41 cases at the Ancoats Hospital (1923–7). In Fraser's[2] series of 400 cases there was a proportion of six males to one female, while Ogilvie[3] found a proportion of four males to one female in 51 cases. Choyce[4] states that the disease is three times as frequent in boys as in girls, while in Starr's[5] experience the disease is slightly more common in boys than in girls.

Age.—It is seen in *Table II* that the disease has a fairly uniform incidence between the ages of 5 and 14, there being 174 cases during these years and 88 cases outside them. Fraser[2] gives the maximum incidence in the 8th to the 12th years, while Platt[1] records 15 cases under 10 years of age, 19 cases from the 10th to the 15th year, and 7 cases over 15 years of age. Ogilvie[3] gives the average age as 12·9 years, and states that in 68 per cent of his cases the age was between 8 and 15 years. Starr[5] states that the majority of cases occur between the ages of 2 and 10.

Table II.—Age Incidence of Acute Osteomyelitis in 262 Cases.

Age	No. of Cases	Age	No. of Cases	Age	No. of Cases
Under 1	6	11	12	0–4	45
1	9	12	25	5–9	85
2	9	13	15	10–14	89
3	11	14	17	15–19	35
4	10	15	9	20 & over	8
5	17	16	13		
6	10	17	5		
7	17	18	5		
8	14	19	3		
9	27	20	2		
10	17	Over 20	6		

Site.—The most common sites of acute osteomyelitis in these 262 cases are the upper end of the tibia and the lower end of the femur, there being 62 examples in the former and 66 in the latter (*see Table X*). Next in frequency are the lower end of the tibia and the upper end of the femur, followed by the fibula and the radius.

Platt[1] gives the following figures from his series of 41 cases: tibia 13, femur 7, fibula 4, humerus 4, radius 3, ilium 4, ulna 2, metatarsus 2, and mandible 1. Fraser's[2] series of 200 cases shows a large preponderance of cases involving the tibia, and the incidence for the different bones is as follows: tibia 87, femur 32, humerus 20, ulna 18, radius 10, fibula 6, pelvis 6, tarsus 10, vertebræ 4, carpus 1, skull 2, and scapula 4. Starr's[5] figures coincide fairly closely with our own. Ogilvie's[6] figures for 51 cases are as follows: tibia 24, femur 13, humerus 4, fibula 4, ilium 3, os calcis 2, pubis 1, and metatarsus 1.

The great frequency of the disease in the neighbourhood of the knee-joint is to be explained by the frequent occurrence of strains, twists, and minor injuries in this situation and by the good metaphysial blood-supply and the size of the epiphysis. The frequency of acute osteomyelitis of the humerus in our series is much less than that recorded by other writers.

Predisposing Causes.—A history of trauma has been found in a relatively high proportion of cases in which inquiry has been made, although in some cases it is recorded that no injury has occurred (*Table III*). The length of time between the trauma and the onset of symptoms is usually less than a

fortnight. In many cases the trauma has been a blow, while almost equally often a history of a twist or a strain has been recorded.

Table III.—Incidence of Trauma.

	Cases
Trauma a 'few days' before onset	10
„ 0–7 days „ „	35
„ 8–14 days „ „	20
„ over 14 days „ „	13
No trauma	25
No record	159
	262

Beekman[7] states that in 60 per cent of his cases a history of trauma was forthcoming, while Ogilvie[6] records a history of injury in 18 of his 51 cases.

It has been very common to find a history of a recent exanthem or to discover that the child has been fretful and unwell for some days before the onset of pain. This prodromal stage is stressed by Platt.[1] Frequently one finds that the patient has recently suffered from a septic finger, a boil, or impetigo, or that such lesions are actually present at the time of admission to hospital.

Causative Organism.—In this series the causative organism has been the *Sta. aureus* in about 90 per cent of those cases in which bacteriological investigation was carried out (*Table IV*); this figure is higher than that given by most writers. There are no cases of osteomyelitis due to the pneumococcus, which figured prominently in Fraser's[2] series.

Table IV.—Bacteriology of Acute Osteomyelitis.

	Cases.
Sta. aureus	66
Sta. aureus and *Str. pyogenes*	2
Str. pyogenes	3
Coliform bacilli	1
Short-chained diplococcus	1
No record	189
	262

Fraser[2], in a series of 400 cases, gives the following figures: *Sta. aureus* 78 per cent, *Sta. albus* 2 per cent, Streptococcus 6 per cent, Pneumococcus 14 per cent, *B. coli* 0·25 per cent, and *B. typhosus* 0·75 per cent. Ogilvie's[6] figures are as follows: *Sta. aureus* 42 cases, *Sta. aureus* with *B. proteus* 1, *Sta. albus* 1, *B. typhosus* 1 (51 cases). In Beekman's[7] cases the infection was caused by the *Sta. aureus* in 75 per cent and by the streptococcus in 10 per cent. The organisms in Lloyd's[8] 39 cases were: *Sta. aureus* 26, Streptococcus 10, Pneumococcus 1; while in Platt's[1] series of 41 cases they were: *Sta. aureus* 33 cases, Streptococcus 4, and *Sta. albus* 1.

PATHOLOGY.

Of the 71 fatal cases, 51 were submitted to autopsy, and of these all except 6 showed pyæmic lesions. Such lesions occasionally involved the lungs only, but were usually widespread, suppurative pericarditis and abscesses

in the kidneys being particularly common (*Table V*). In addition there are recorded 12 cases in which recovery took place after the treatment of pyæmic lesions, and it is probable that many more patients had small pyæmic abscesses in the lungs and kidneys which subsided without giving rise to symptoms. It is, therefore, important to realize that the onset of pyæmia by no means invariably necessitates a fatal issue. Fagge[9] states that chest complications, as indicated by pleuritic rub, pericardial friction, or cardiac murmurs, are very serious, and that in every case in which any of these signs have appeared, the result has been fatal. We can record one case of recovery after drainage of an empyema following acute osteomyelitis, and one of us (L. N. P.) can record a case which recovered after the drainage of a pyopericardium; this complicated an acute osteomyelitis of the upper end of the femur in a boy of 10 years of age.

Table V.—Results of Autopsy in 51 Cases of Acute Osteomyelitis.

	Cases
Total number of autopsies	51
Acute pericarditis	33
Acute pleurisy or empyema	10
Abscesses or infarctions in lungs	22
Abscesses in kidneys	18
Acute arthritis	9
Metastatic osteomyelitis	4
Subcutaneous and intermuscular abscesses	9
Abscesses in myocardium	7
Abscesses in thyroid gland	1
Abscesses in spleen	3
Abscesses in prostate	1
Abscesses in liver	2
Acute duodenal ulcer	1
No pyæmic lesion found	6

Ogilvie,[6] recording the incidence of pyæmic lesions in his series of 51 cases, gives 11 cases of joint involvement, 9 of metastatic bone abscess, 3 of suppurative pericarditis, 1 case of meningitis, and metastatic abscesses as follows—myocardium 6, lungs 3, pleura 2, kidney 2, and soft parts 3.

Table VI shows the incidence of pyæmic lesions in which recovery followed treatment by drainage.

Table VI.—Pyæmic Lesions in 12 Cases of Acute Osteomyelitis which Recovered.

Site	Number	Details
Bone	8	2 fibula, 2 humerus, 1 each tibia, radius, inferior maxilla, cuboid
Joints	3	Hip, knee, sterno-clavicular
Empyema	1	—
Suppurative pericarditis	1	—
Subcutaneous abscesses	6	Chest wall, buttock, etc.

Of the 6 cases which at autopsy showed no pyæmic lesions, 2 were cases of acute osteomyelitis of the ilium and of the lower end of the femur respectively. The former, in which death occurred three weeks after operation, was found on autopsy to have an acute suppurative sacro-iliac arthritis; the latter died over three months after the first operation, following amputation of the leg necessitated by the development of an acute suppurative arthritis of the knee-joint. The other 4 cases died of septicæmia on the first, second, third, and fourth days respectively after operation; they were all cases of osteomyelitis of the lower end of the femur.

SYMPTOMATOLOGY.

The length of history, as judged by the duration of pain, before admission to hospital was usually under seven days (*Table VII*).

Though in a surprisingly large number of cases the temperature on admission to hospital was less then 100°, the pulse-rate was 120 or more per minute in the majority of cases (*Table VIII*).

Table VII.—Length of History Before Admission to Hospital.

	Cases
'Few days' pain before admission	14
0–4 days „ „	70
5–9 „ „ „	35
Over 9 days „ „	41
No record	102
	262

Table VIII.—Temperature and Pulse-rate on Admission to Hospital.

Temperature on Admission		Pulse-rate on Admission	
Under 100°	87	Under 100 per minute ..	38
100°–101°	52	100–120 „ „	64
101°–102°	37	120–140 „ „	88
102°–103°	34	Over 140 „ „ ..	43
103°–104°	18	No record	29
Over 104°	5		
No record	29		
	262		262

In cases of acute osteomyelitis of the long bones, the symptoms and signs are usually so typical that no difficulty arises in diagnosis. Platt[1] stresses the importance of recognizing a prodromal stage of the disease during which a small focus in the metaphysis is smouldering. This stage is characterized by fixed pain at the end of a long bone, and by tenderness on pressure of the metaphysis. In this stage also there is often an intermittent limp.

Acute osteomyelitis of the upper end of the femur is not always easy to recognize. A local sign of importance is tenderness over the greater

trochanter and in Scarpa's triangle, while should the hip-joint be involved, the limb is held in a position of flexion, abduction, and eversion, and the slightest attempt at passive movement elicits excruciating pain.

There is, except in the most fulminating cases, a leucocytosis of polymorphic cell type, the count often reading 25,000 cells per cubic millimetre. It must be emphasized that at this stage there is no radiological evidence of bone disease. Radiological signs do not appear until about the twelfth day, when some haziness of outline indicates periosteal reaction.

We should like to draw attention to the frequency with which osteomyelitis of the small bones of the foot mimics cellulitis of the foot. There have been eight such cases in our series. The whole foot is usually red, swollen, and acutely tender. After rest and local heat have been applied for a time, the infection becomes localized. Incision at this stage evacuates a small amount of pus or only some serous fluid, the condition being regarded as a cellulitis and subsiding in a few days. The wound, however, fails to heal completely, and a sinus remains. An X-ray examination made some weeks later reveals the changes resulting from an old acute osteomyelitis, and sequestra are usually found. In every case, therefore, of apparent cellulitis of the foot, especially if there is no obvious causative abrasion or wound, it is necessary to consider the possibility of infection of one of the smaller bones. One such case (included in this series) is recorded below :—

C. H. B., male, age 9, was admitted to Leeds General Infirmary on Oct. 19, 1926, with a swollen, red, painful left foot ; a diagnosis of cellulitis of the foot was made and the inner side of the foot was incised. A considerable amount of pus was evacuated, and the patient left hospital on Nov. 2, 1926, with the wound still draining. The sinus persisted, and in December, 1926, a radiogram showed a large sequestrum in the shaft of the first left metatarsal bone. On Dec. 11, 1926, the sinus was excised and the sequestrum was removed ; the boy made an uneventful recovery.

TREATMENT AND RESULTS.

Every case in the series has been subjected to operation, and particulars of the operations performed and of the mortality are given in *Table IX*. *Table X* gives the mortality according to the bone involved, and *Table XI* the time of death.

Table IX.—Operations Performed and Mortality.

Operation	Deaths	Recoveries	Total
Primary gutter operation	52	124	176
Primary partial diaphysectomy	1	19	20
Primary periosteal incision only	11	35	46
Primary periosteal incision : diaphysectomy later ..	1	2	3
Primary periosteal incision : gutter operation later..	4	11	15
Winnett Orr's method	2	0	2
	71	191	262

Table X.—Bone Involved, with Mortality.

Bone		Deaths	Recoveries	Total
Femur	Upper end ..	7	15	22
	Lower end ..	22	44	66
	Not stated ..	3	1	4
Tibia	Upper end ..	24	38	62
	Lower end ..	3	24	27
	Not stated ..	2	5	7
Fibula	Upper end ..	1	7	8
	Lower end ..	1	14	15
	Not stated ..	0	3	3
Humerus	Upper end ..	0	7	7
	Lower end ..	3	3	6
	Not stated ..	2	2	4
Radius	Upper end ..	0	1	1
	Lower end ..	1	12	13
Ulna	Upper end ..	0	1	1
	Lower end ..	0	2	2
Ilium		1	1	2
Os calcis		0	4	4
First metatarsal		0	2	2
Second cuneiform ..		0	1	1
First phalanx, hallux ..		0	1	1
Mandible		1	0	1
Vertebral column, lumbar		0	1	1
Clavicle		0	2	2
Total		71	191	262

Table XI.—Showing Time of Death after Operation.

Time of Death	Number
Under 24 hours ..	5
1 day	7
2 days	7
3 ,, ...	5
4 ,, ...	6
5 ,, ...	3
6 ,, ...	2
7 ,, ...	2
8 ,, ...	2
9 ,, ...	2
10–14 ,, ...	6
15–20 ,, ...	11
21–28 ,, ...	6
Over 28 ,, ...	7
Total	71

The following is a brief description of the various methods of treatment as carried out in our series of cases :—

1. **Incision and Drainage.**—The end of the affected bone is approached by the orthodox route, and the subperiosteal abscess is incised for its full length and the pus is allowed to escape. The wound is left open, and treated usually by irrigation through Carrel tubes. Various antiseptics have been used, such as Dakin's solution, flavine 1–1000, hypertonic saline, and, more recently, quinanil. Occasionally the wound has been packed with gauze soaked in one of these substances. We have not been able to show that any one of these antiseptic substances has given better results than the others, and the antiseptic that has been used most is Dakin's solution. This operation has been performed in 64 cases. In 46 cases no further operation was needed in the acute stage of the disease, but the removal of sequestra was usually necessary later; in a few cases a small flake-like sequestrum about one inch in diameter has separated after some weeks, and has been removed. Although simple periosteal incision with drainage has been performed for many cases of low virulence—including some of the cases of osteomyelitis of the small bones of the foot—it has also been performed on several patients who at the time of admission to hospital were too ill to allow of a more radical operation being performed. In the majority of such cases it was necessary some days later either to open the medullary cavity or to remove the shaft of the bone. In this series there were 18 cases in which a secondary operation was performed, and 13 of them recovered.

2. **Primary Diaphysectomy.**—This operation, which has been done in 20 cases with only 1 death, has only been performed in selected cases. There have been 8 cases for which partial diaphysectomy of the fibula has been performed; this is a bone in which the extensive stripping of the periosteum, which so often occurs, suggests diaphysectomy as a simple method of treatment. In the fibula there has been no case of failure of regeneration of the bone. Diaphysectomy has been done six times for osteomyelitis of the radius, and in every case there was considerable late deformity from either partial or total failure of regeneration of the bone. This operation has also been performed twice for acute osteomyelitis of the tibia (amputation was needed later), once for acute osteomyelitis of the first phalanx of the hallux, three times for acute osteomyelitis of the clavicle, and once for the ulna.

3. **Gutter Operation.**—In our series this operation has been the routine procedure for the more acute cases, particularly in the femur and the tibia. The metaphysis is exposed and the periosteum incised. The compact bone is then removed by chisel for about one-third of the diameter of the bone. We regard it as particularly important that the removal of bone should extend right up into the metaphysis. In the other direction the bone is opened until healthy normally bleeding marrow is seen. Where little or no pus is seen, this extensive opening of the bone is modified. The wound is then either packed with gauze soaked in antiseptic or Carrel-Dakin treatment is instituted. In all, 176 cases have been treated by this method as a primary operative procedure, and 52 have died.

Two cases, in addition, were treated in accordance with the principles laid down by Winnett Orr. After the usual gutter operation the wound was packed with vaseline gauze and the limb was immobilized in plaster-of-Paris; both these cases died.

COMPLICATIONS.

Apart from septicæmia and pyæmia, the most important complication in its danger to life is infection of neighbouring joints. This is to be expected in such sites as the upper and lower ends of the femur, and the lower end of the humerus, where the metaphysis is partly intra-articular. We have found, however, that the greatest incidence of joint involvement occurs in cases of acute osteomyelitis of the upper end of the tibia (*Table XII*). All writers stress the importance of the attachment of the periosteum to the epiphysial cartilage in preventing the spread of infection to the joint. We should like to emphasize the importance of carrying the incision in the periosteum right up to the epiphysial line, so that there may be no undrained collection of pus at this place; such a procedure is of especial importance at the upper end of the tibia, since the periosteum over the metaphysis is covered by the insertions of gracilis, sartorius, and semitendinosus, and by the internal lateral ligament of the knee-joint.

When an acute arthritis is established, harm is done by delay in treatment. Aspiration should not be persisted in if no improvement occurs. Arthrotomy should be done early, and, above all, amputation must be considered early. Many lives are lost through delay in deciding to amputate. Fagge[9] stresses the importance and seriousness of joint involvement, and says that it is his impression that no case in his experience complicated by a frankly purulent arthritis has escaped amputation at Guy's Hospital.

Amputation has been performed in this series in 12 cases (*Table XII*), in most of which acute arthritis of the neighbouring joint has complicated the osteomyelitis; in a small number secondary hæmorrhage has necessitated amputation.

Table XII.—Incidence of Acute Arthritis and of Amputation.

Acute Arthritis	Died	Recovered	Total	Cases of Osteomyelitis of Bone Named
Acute arthritis of knee from acute osteomyelitis of tibia	7	11	18	62
,, ,, of knee from acute osteomyelitis of femur	3	6	9	66
,, ,, of hip from acute osteomyelitis of femur	3	6	9	22
,, ,, of ankle from acute osteomyelitis of tibia	1	3	4	27
,, ,, of ankle from acute osteomyelitis of fibula	—	2	2	15
,, ,, of knee—pyæmic from acute osteomyelitis of fibula	—	1	1	—
,, ,, of knee—pyæmic from acute osteomyelitis of upper end of femur ..	1	—	1	—
Incidence of acute arthritis ..	15	29	44	—
Amputations				
Acute osteomyelitis of lower end of femur	2	1	3	
,, ,, ,, upper end of tibia	2	6	8	
,, ,, ,, lower end of tibia	—	1	1	
	4	8	12	

DISCUSSION.

The mortality in this and in other recent series of cases is shown below :—

	Cases	Deaths	Percentage
Pyrah, L. N., and Pain, A. B., 1932	262	71	27·1
Gwynne Williams, 1932	91	18	19·8
Lloyd, E. I., 1932	40	13	32·5
Ogilvie, W. H., 1928	51	11	21·6
Mitchell, A., 1928	70	10	14·3

The recent work of Starr, of Toronto, has thrown new light upon the pathology of acute osteomyelitis. He has shown that infection spreads from the metaphysis to the subperiosteal space very early in the course of the disease, but that it spreads much later to the cancellous tissue of the shaft, and when such infection does arise it occurs not by direct continuity from the metaphysis, but by the entry of infection into the cancellous tissue from the subperiosteal abscess at different levels by way of the Haversian and Volkmann's canals. Thus, in the early stages of the disease the presence of a large subperiosteal abscess does not imply extensive medullary infection. Starr advised simple periosteal incision for those cases in which pus is found under the periosteum ; if no pus is found there, the metaphysis is to be drilled or trephined obliquely towards the epiphysial line.

It is a corollary of Starr's work that localization of infection will be most advanced at the metaphysis ; that in the diaphysis remote from the epiphysis there will be islands of infected cancellous tissue in gradually diminishing states of localization. It is a sound surgical principle that localized pus must be evacuated by incision and that the abscess cavity must be drained. The treatment of spreading unlocalized inflammation cannot be so dogmatically stated. Incision into an area in which such unlocalized, perhaps rapidly spreading, inflammation is present will on the one hand give exit to toxic material and to accumulating inflammatory débris, but on the other hand it must inevitably open up tissues which can allow of the rapid absorption of toxic material by veins and by lymphatics into the general circulation. In the treatment of acute lymphangitis it is now amply established by experience —particularly since the appearance of Kanavel's book[10]—that conservative treatment must be adopted until the lymphangitis has been controlled by heat and rest and that incisions into the primary focus of infection must only be made when pus has formed. The indiscriminate incision of such foci during the stage of progressive inflammation usually causes elevation of temperature and definite increase in the toxæmia of the patient. The treatment of cellulitis of the subcutaneous tissues is in general guided by similar principles. The day of multiple incisions for rapidly-spreading cellulitis has passed ; by rest and by the application of heat such localization of the infection can usually be obtained that one or two incisions made when pus has formed are all that is necessary. Such incisions, made when shutting-off of the infected zone has occurred, do not at all risk an increase of toxæmia, but promote its immediate and steady decrease. If the principles outlined here are applied to the treatment of acute osteomyelitis it would appear that those cases of great severity—whether from the great virulence of the infecting organism

or from the lack of resistance in the patient—should be treated by conservative methods such as simple periosteal incision; the bone should only be opened in those cases in which obvious and definite pus has accumulated.

We will now consider the series of cases here recorded in the light of the arguments advanced above.

In this series 64 cases have been treated by primary incision of the periosteum, and of these 16 have died (25 per cent mortality). Some of these have needed a secondary operation later. While many of these cases were mild cases in which the surgeon judged that the opening of the bone was not necessary and from whom a small sequestrum separated at a later date, very many were (to our definite knowledge) advanced cases in whom simple drainage was effected because the child was too ill to withstand radical drainage of the bone. Nevertheless the average results of this form of treatment are much better than those of the gutter operation. It is to be noted that the amount of sequestrum formation is much less than the area of compact bone from which the periosteum has been stripped.

The gutter operation has been performed (in this series) in most cases of average severity; there were 176 such cases in all, with 52 deaths. The mortality (29·5 per cent) of this group is considerably higher than that of the cases treated by primary simple periosteal incision. In performing the gutter operation the surgeon has usually removed compact bone from the region of the metaphysis along the shaft to a point where apparently healthy bleeding marrow has been observed, and definitely past the zone where oily (but usually not frankly purulent) marrow has been present. Inevitably therefore a considerable portion of marrow has been exposed where infection by way of the Haversian canals has but just occurred and where imperfect localization has been present; in doing this some blood-sinusoids have been opened which could allow general systemic absorption. We think that this is responsible for the higher mortality in this group of cases. The operation, undertaken to promote drainage of toxic exudation, must often have promoted exactly the reverse, namely absorption. Starr advocated the opening of the metaphysis by a small trephine or by a drill; this simple relief of tension in a rigid structure such as bone can scarcely be harmful provided that nothing further is done *if no pus is found.*

We think that the results of this extensive series of cases and the arguments we have put forward give support to what is definitely a strong tendency among most surgeons who have recently written upon acute osteomyelitis—namely, the more conservative treatment of the disease.

In a case of average severity the subperiosteal abscess should be incised for approximately its full length, and particular care should be taken to see that the incision reaches the epiphysial cartilage, since, as Starr showed, it is in the region of the epiphysial line that pus escapes from the cancellous tissue by one of the vascular foramina. The region of the metaphysis should then be explored either by a small trephine or by a drill. *If frank pus is found* upon such an exploration of the bone, compact bone should be removed only so far as to uncover the zone occupied by the pus and no farther. Provision should be made for drainage and for irrigation. From the few cases which we have seen treated by the method of Winnett Orr we cannot

advocate it; too few cases, however, have come under our observation for us to be dogmatic about this method. *If no frank pus is found* upon exploration of the bone by trephine or drill, no further opening-up of the bone should be done.

If the patient is very ill or if the case is one of a very acute type in which a subperiosteal abscess of considerable size has formed within two or three days and in which the toxæmia is very profound, periosteal incision only should be done; in some cases that survive it will probably be necessary to open the bone some days later.

SUMMARY.

1. A series of 262 consecutive cases of acute infective osteomyelitis is reported. Of these, 71 died, giving a mortality of 27·1 per cent.

2. Consideration of general principles, of the pathology of the disease, and of the methods of treatment employed in the cases in this series seems to point to the value of moderately conservative treatment for acute osteomyelitis.

We wish to thank the members of the Honorary Surgical Staff of the Leeds General Infirmary for permission to record the cases which have been under their care.

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'HYPERTROPHY OF THE PYLORUS' IN AN ADULT.

By P. T. CRYMBLE and THOMAS WALMSLEY, Belfast.

The following case of 'hypertrophy of the pylorus' in an adult is worthy of record on account of the rarity of the condition, but even more so, we believe, on account of the remarkable arrangement of the parts which was discovered at the anatomical examination of them after their removal by operation.

The condition occurred in an adult male, age 43 years, married, and by occupation a labourer. He appeared to be, on general inspection, an ordinarily developed man though a little spare, and certainly he had none of the appearances of serious nutritional disturbance. He had had, he said, no gastric symptoms until he was 40 years of age, but more detailed inquiry from his relatives established "that when he was a small boy he was unable to eat fried eggs and meat and had to have light food, that he occasionally vomited, and that he was often troubled with indigestion", and also "that from the age of 16 years he was always careful in what he ate, as meat and potatoes did not agree with him." He had had, however, no medical attention for these complaints, and his other illnesses were unconnected with his present condition. Three years before admission, at the age of 40, he began to have gastric pain commencing about an hour after food, "burning sensations in the stomach, and waterbrash"; the pain was relieved by vomiting. The symptoms progressively became worse in spite of greater care in diet and occasional medical treatment, and there was some loss of weight; at no time had blood been vomited.

Fig. 352.—'Immediate opaque meal': photographed in the erect position.

The opaque-meal examination showed "extreme 7-hour gastric retention"; and obviously in the 'immediate' photograph (*Fig.* 352) there is obstruction at the pylorus and no filling of the first part of the duodenum. The stomach is of the J-shaped type, and the lowest point of the lesser curvature is below the intercristal line; it appears, however, to have good

tone, even in the fundal part of the greater curvature, and though it is enlarged there is no more than a relative increase in the transverse diameter. It is considered now that the pyloric canal is empty, the possibility of a sagittally-placed first part of the duodenum having been taken into account.

At operation the stomach was found to be enlarged and its wall to be thickened. There was a firm 'tumour' at the pylorus of the size of a golf ball. It was covered with normal peritoneum, was freely movable, and to external examination seemed completely to obliterate the pyloric lumen; it was recognized of course that its size and density precluded any estimate of the dimensions of the lumen. The commencement of the duodenum appeared to be normal in all respects. The lower half of the stomach and a small part of the duodenum were removed, and the alimentary canal was restored by a retrocolic end-to-side gastro-enterostomy.

The removed specimen consisted of a portion of the stomach 5 in. long, and included the lower part of the body and the whole of the pyloric part of the stomach and a narrow strip of the beginning of the duodenum. It had been slit along the lesser curvature. It was pinned out flat in Zenker-formol solution. The mucous membrane of the whole area, except over the pyloric mass, was slightly thickened, œdematous, and congested, and was covered with a small amount of mucus, but there were no signs of gross inflammatory or even catarrhal changes. In the area of the pyloric antrum there were four clotted surface hæmorrhages of bright red blood, two on the anterior and two on the posterior wall, and all of them much nearer the lesser than the greater curvature—that is, they were within the area of the *Magenstrasse*. Each hæmorrhage was circular in surface outline and about 1 cm. in diameter, and from each 'a stalk of blood' was continued into the mucous membrane through its surface. These hæmorrhages represent extravasations from the subepithelial plexus of mucous membrane veins.*

The examination and measurements of the cut surface of a block taken from the pyloric antrum demonstrate the conditions of general muscle hypertrophy (the circular muscle is on an average 3 mm. thick and the longitudinal muscle 1·25 mm. thick), œdema of the submucosa, and slight vascular engorgement and œdema of the mucous membrane—that is, there is present a powerfully acting muscle wall of the stomach. Microscopic examination of this region demonstrates dilated capillaries in localized areas, and near the superficial surface of the mucous membrane, in the zone of the superficial venous network, there were numerous capillary hæmorrhages.

A longitudinal section through the pyloric end of the stomach, parallel with and close to the greater curvature, and a diagram which gives the

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* These veins are fairly large vessels. They are drained by rather fine vertical vessels which have little anastomoses and are valveless, and which connect the superficial and deep mucous membrane plexuses. The rupture of the superficial vessels in this region near the lesser curvature will be favoured by the much more close adherence of the mucous membrane to the muscle coat here than elsewhere in the stomach wall. The discussion of the mechanism of these hæmorrhages does not arise in this paper. It is of course well known that they occur in many abnormal gastric conditions, and their relation to ulcer formation has been freely discussed (see, for example, Disse, *Arch. f. mikros. Anat.*, 1904, lxiii, 512). Vomiting of bright-red blood in conditions of pure pyloric obstruction has been recorded by Bastianelli (*Ann. of Surg.*, 1925, lxxxi, 45).

dimensions of the parts, are shown in *Fig.* 353. It shows the great hypertrophy of the circular muscle which formed the 'tumour', the sudden commencement of the hypertrophy, and that it exists in the whole length of and is confined to the pyloric canal. It shows, too, that the longitudinal muscle, which is 1·25 mm. thick in the antrum, is very much thinner over the 'tumour' —that is, is not hypertrophied, but rather in fact is less than normal in thickness. It also shows that in the pyloric antrum the mucous membrane is folded and the submucous layer is increased in amount and loose and

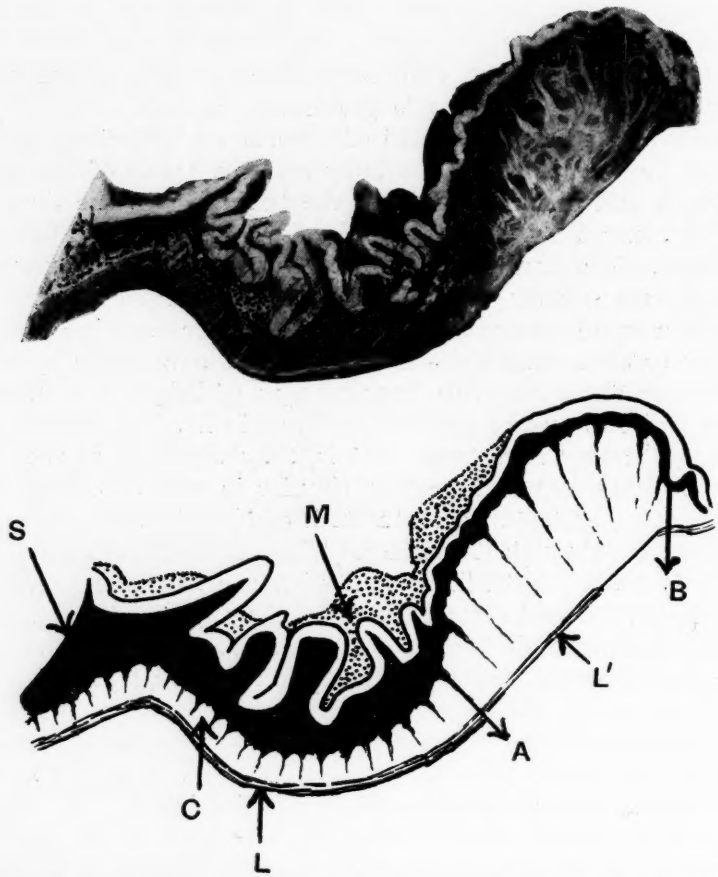

FIG. 353.—Photograph of a longitudinal section through the pyloric end of the stomach near the greater curvature. (*Natural size.*)

Below is a diagram to show the dimensions of the parts, after fixation. A–B = 3·4 cm. (the length of the hypertrophied part at the lesser curvature was 2·5 cm.); C, Circular muscle, 3mm.; L, Longitudinal muscle, 1·25 mm.; L′, 0·5 mm.; M, Mucous membrane; S, Submucosa. Greatest thickness of pyloric mass, 1·5 cm.

œdematous; and that in this region there is a uniform and thickened circular muscle coat and a distinct and thickened longitudinal muscle coat. The mucous membrane over the 'tumour' is practically unfolded, and it is obvious that it is much more closely and firmly bound to the muscle; and, as is shown in *Fig.* 354, the duodenal mucous membrane covers the whole of the duodenal face of the 'tumour'.

The hypertrophied mass consists of bundles of normal visceral muscle which are looser in their arrangement and embedded in a greater amount of fibrous tissue than is usual in smooth muscle (*Fig.* 354). The fibrous tissue is continuous with that of the submucous layer. In the internal parts of the mass the muscle bundles are almost entirely circular in direction, but more superficially they are oblique or vertical and here they freely interlace with one another; and these bundles are continuous with, and appear to be extensions of, a more or less normal layer of circular muscle which underlies the thin layer of longitudinal fibres on the surface. In the position where

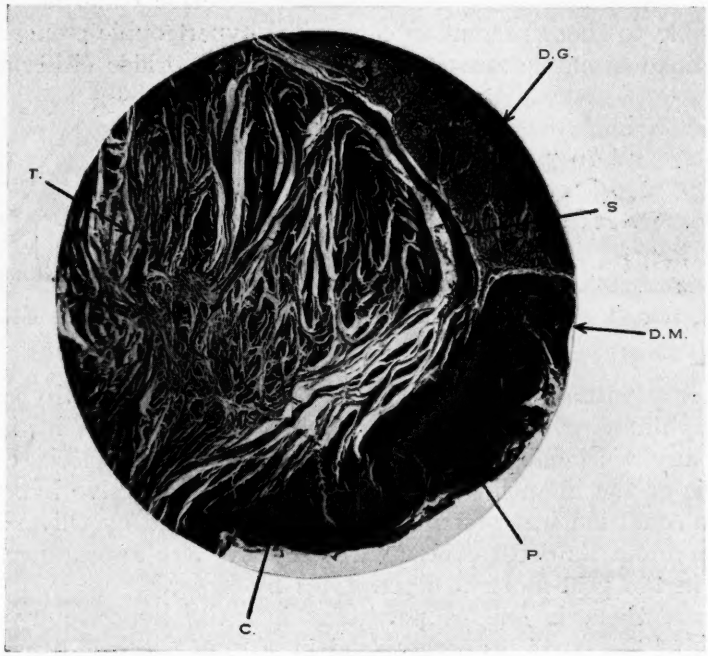

FIG. 354.—Microphotograph of the duodenal end of the hypertrophied mass. The normal pyloric sphincter is shown, entirely separated from the hypertrophied mass. (There is continuity between the pyloric and duodenal muscle in this specimen.) DG, Duodenal glands; S, Submucosa; DM, Duodenal muscle; P, Pyloric sphincter proper; C, Circular muscle; T, Hypertrophied mass.

the normal pyloric sphincter would be, however, and over an extent that would correspond with that of a normal sphincter, the normal circular fibres are thickened as they would be in a normal, though small, pyloric sphincter; and over this sphincteric thickening the superficial longitudinal layer almost disappears as such, as it does over the normal pyloric sphincter (*Fig.* 354). It is further to be noted that this normal pyloric sphincter makes no contribution to the hypertrophied mass, and is in fact separated from the duodenal end of the mass by a layer which is seen to be continuous with the submucosa and the muscularis mucosæ, and which, in the photograph, turns to the left over the proper sphincter (*Fig.* 354). These arrangements of the parts are represented diagrammatically in *Fig.* 355.

The gross arrangement of the parts in this case obviously resembles that

which is described in cases of 'congenital hypertrophic stenosis of the pylorus'; and we have been forced to the conclusion that the condition which is described here is a persistence into adult life of the infantile condition, with, probably, an increase in the hypertrophy—rather than an atrophy in the muscle of the other parts of the stomach—in the three years before admission. Such cases are extremely rare. It is now well recognized that chronic gastric disturbance in the adult may be due to obstruction at the pylorus which is not of the nature of reflex spasm or of cicatricial pyloritis, and several reports have been published of the anatomical findings in such cases as displayed at operation. The majority of these reports, for example those of Maylard,[1] Bastianelli, Cautley and Dent, and Landerer, describe conditions which are not comparable to those present in congenital hypertrophic stenosis—that is, there is in them a simple narrowing of the pyloric orifice either without or

FIG. 355.—A diagram of the arrangement of the muscle tissue: founded on *Figs.* 353 and 354.

more commonly with what is stated to be a simple ring-like hypertrophy of the pyloric sphincter;* and this hypertrophy, when it is present, is unaccompanied by any thickening of the musculature of the pyloric canal as is characteristic of the infantile condition. The more extensive hypertrophy of the infantile condition was present in the case described by Oliver[2] in a man, age 51 years; and its occurrence, and even fairly late appearance, was fully established in the post-mortem descriptions by Maier.[3]

This case, then, is one of persistent infantile hypertrophy; and the arrangement of the parts, as represented in *Fig.* 355, seem to us to call for a re-examination of the pathological anatomy of 'infantile hypertrophy of the pylorus'—namely, that the hypertrophy does not affect the pyloric sphincter, which, indeed, rather remains undeveloped, but is only of the muscle wall of the whole length of the pyloric canal.† This thesis, which is supported by the study of the development of the parts, is the subject-matter of a following communication.

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* It must be extremely difficult at operation to decide what is and what is not a hypertrophied pyloric sphincter, apart altogether from the appearances of an oblique section of it; for the limits of the anatomical normal are very wide.

† That is, of course, the pathological hypertrophy, for there is usually a functional hypertrophy of most of the stomach wall and also of the first part of the duodenum.

AN EXPERIMENTAL INQUIRY INTO THE ASSOCIATION BETWEEN GALL-STONES AND PRIMARY CANCER OF THE GALL-BLADDER.

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By some clinicians gall-stones are regarded as causal agents of biliary cancer. The foundations for this opinion are: (1) The frequency with which calculi are present in cases of primary carcinoma of the gall-bladder; and (2) The alleged experimental production of cancer by the insertion of foreign bodies into the gall-bladders of animals.

With the clinical evidence it is not the writer's purpose to deal, beyond remarking that the frequent association of cholelithiasis with carcinoma of the gall-bladder cannot in itself be regarded as a proof that either condition has caused the other. Both calculus and cancer may have developed in response to a common agency. Such a coincidence has been known to occur in the kidney, as the following example will show. Daels and Biltris[1] inserted a strip of collodion impregnated with radium sulphate into the kidney of a guinea-pig, which, twenty-two months later, was found to have (1) lithiasis, and (2) sarcoma of the kidney so treated. In this instance the sarcoma is to be attributed to the radium rather than to the calculus for several reasons, among which is the fact that Daels and Biltris were able in the same series of experiments to induce tumours by radium in other regions of the guinea-pig's body without the accompaniment of calculi.

In connection with the experimental side of the matter definite statements have been made to the effect that cancer of the gall-bladder has been produced by inserting gall-stones and other foreign bodies into its cavity, and such statements have received wide acceptance. The supposed experimental proofs will be discussed below.

LABORATORY EXPERIMENTS.

The first attempt to apply experimental tests in the laboratory was made by Kazama,[2] who introduced various foreign bodies into the gall-bladders of 98 guinea-pigs and produced cancer, as he believed, in 26 of these, 9 of the cases being accompanied by metastasis (*Table I*).

Leitch[3] undertook a repetition of Kazama's experiments, and inserted gall-stones into the gall-bladders of 25 guinea-pigs, pebbles into the gall-bladders of 5, and pilules of pitch into 5, and claimed to have brought about cancer in 8 of the animals within a year and a few days—5 of these cancers occurring within the first six months. Of the 8 cancers, 5 were caused by gall-stones, 2 by pebbles, and 1 by a pilule of pitch. Fifteen of the animals

were still alive a year after the operation, but their ultimate fate has not been recorded.

Nakamoto Joshiharu is mentioned by Genkin and Dmitruk[4] as having produced cancer of the guinea-pig's gall-bladder by the insertion of foreign bodies, but I have been unable to find a published report of his work.

Table I.—Results of Inserting Foreign Bodies into the Gall-bladders of Guinea-pigs (Kazama).

Nature of Material inserted into Gall-bladder	Number of Guinea-pigs used	Maximum Duration of Life after Operation	Cases in which Cancer was produced	Cancer Cases with Metastasis
		Months		
Pebbles	30	$4\frac{1}{4}$	4	4
Suture material	23	3	6	1
Mucous membrane from gall-bladder	2	$1\frac{3}{4}$	2	1
Pityrol	16	$5\frac{1}{2}$	8	0
Lanolin	27	$4\frac{1}{2}$	6	3
Totals	98		26	9

Clemente[5] made similar experiments, inserting balls of tar mixed with cement 'the size of chick-peas' into the gall-bladders of 20 guinea-pigs. Nine of these animals died accidentally of 'insolation' three and a half months after the operation. The gall-bladders of these animals were thickened, hard, and adherent to the omentum and liver. Microscopical examination revealed the presence of neoplastic elements having a marked power of growth and invasion. The proliferative changes, he says, lead by progressive stages to adenoma, which afterwards gives place to atypical epithelial proliferation which in all probability can be interpreted as cancerous. All of these animals had increased in weight after the operation, the average increase at death being 122 grm. Professor Clemente[6] has with great kindness informed me of the fate of the survivors of this series and has generously given me permission to quote his observations. He says, "the results obtained in the 11 surviving guinea-pigs were not worth recording in an article. In fact, in most cases the gall-bladder was found to be intact, and there was no trace of the substance inserted. In the remaining cases there was true atrophy of the organ itself with retraction of the bile-ducts. Histological examination in these cases revealed sclerosis predominating on the epithelial proliferation. But even so, no characteristic lesions were found such as to recall those already described in the nine other guinea-pigs."

Delbet and Godard[7] inserted gall-stones from cancerous patients into the gall-bladder of 6 guinea-pigs and from non-cancerous cases into 10 guinea-pigs. Similar results followed in both groups. On examination at intervals varying from eight to nineteen months afterwards, the conditions found were fairly constant—namely, a thickening of the wall of the gall-bladder with

FIG. 356.—*Case* 1.

FIG. 357.—*Case* 2.

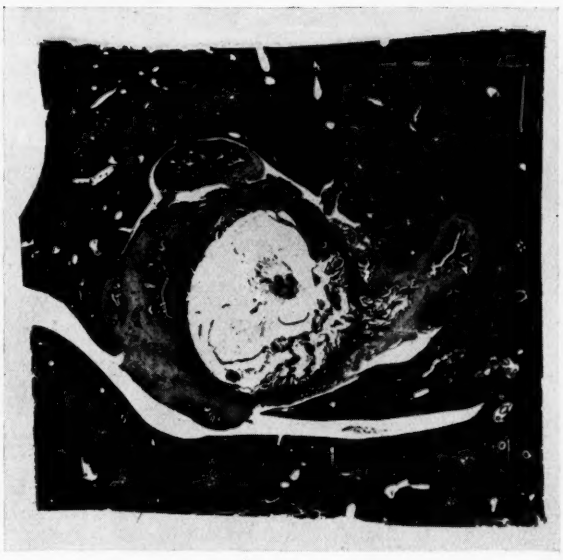


FIG. 358.—*Case* 3.

FIG. 359.—*Case* 4.

FIG. 360.—*Case* 5.

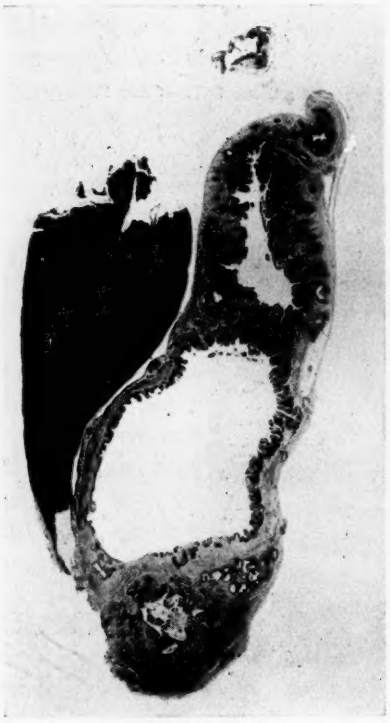


FIG. 361.—*Case* 6.

FIG. 362.—*Case* 7.

FIG. 363.—*Case* 8.

FIG. 364.—*Case* 9.

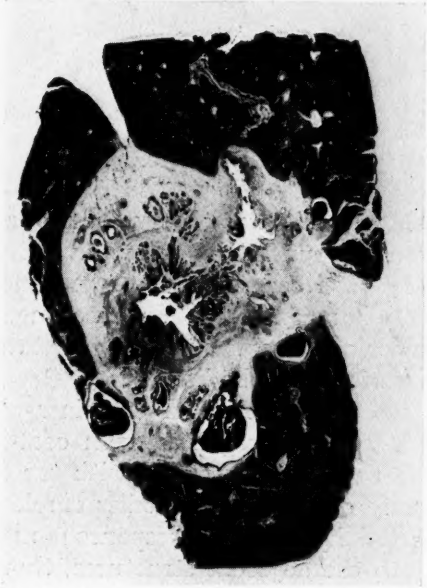


FIG. 365.—*Case* 10.

FIG. 366.—*Case* 11.

pronounced hyperplasia of the glandular elements, which formed cysts and tended to invade the liver. The interpretation of the microscopical sections was not always easy, and changes which might be called 'precancerous' were observed. In 2 of the cases the appearances were suggestive of cancer. The authors criticize the former work of Kazama and Leitch, and do not regard their own work as having proved that cancer can be caused in the guinea-pig by the presence of gall-stones in the gall-bladder.

Petrov and Krotkina[8] introduced human gall-stones, either alone or together with paraffin and coal-tar, into the gall-bladders of 30 guinea-pigs. The experiment lasted twenty months, and in all the animals they found a

FIG. 367.—*Case* 12.

FIG. 368.—*Case* 13.

striking degree of epithelial hyperplasia. Metaplasia was observed, and areas of atypical epithelial proliferation were seen surrounded by connective tissue and leucocytic infiltration. The picture is described as that of precancer, though not of definite cancer, and they do not consider their experimental work to have proved the occurrence of cancer as a result of chronic irritation of the gall-bladder caused by the presence of foreign bodies.

Gioia[9] introduced various substances into the gall-bladders of guinea-pigs, including smooth pebbles, chips of pumice stone impregnated with coal-tar, and fragments of Chamberland filter which had been saturated with tar dissolved in xylol. Independently of the nature of the foreign bodies employed there followed a vigorous fibro-myo-epithelial hyperplastic response; moreover, the formed epithelial tissue spread into the adjacent structures, though not by infiltrating the lymphatics. This hyperplastic response to injury took place with remarkable speed. In one animal which died thirty-six

FIG. 369.—*Case* 14.

FIG. 370.—*Case* 15.

FIG. 371.—*Case* 16.

FIG. 372.—*Case* 17.

FIG. 373.—*Case* 18.

FIG. 374.—*Case* 19.

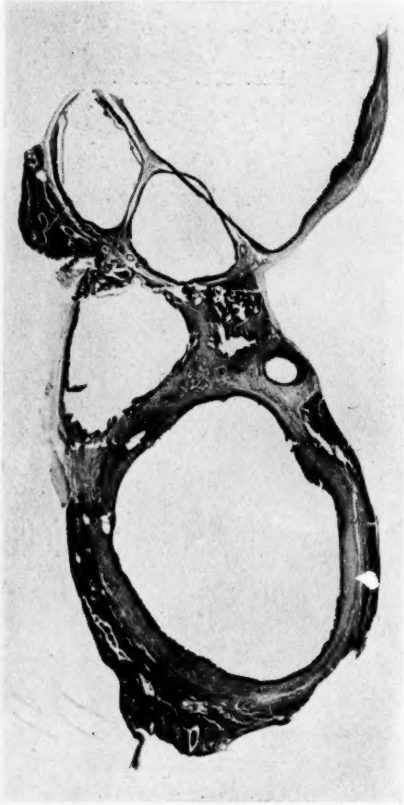


FIG. 375.—*Case* 20.

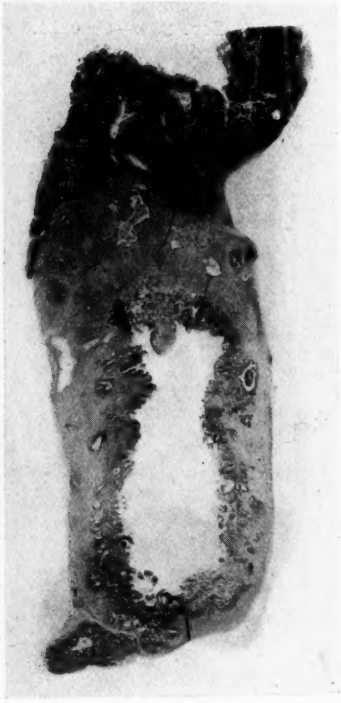


FIG. 376.—*Case* 21.

hours after the operation active epithelial proliferation with papillary formation was already in evidence. In none of his 17 cases could the death of the animal be attributed to the condition of the gall-bladder or of the adjacent organs. Although in some cases the microscopical appearances could be regarded as precancerous or as those of early cancer, in no case did metastasis or cancerous invasion of the neighbouring organs occur.

FIG. 377.—*Case* 22.

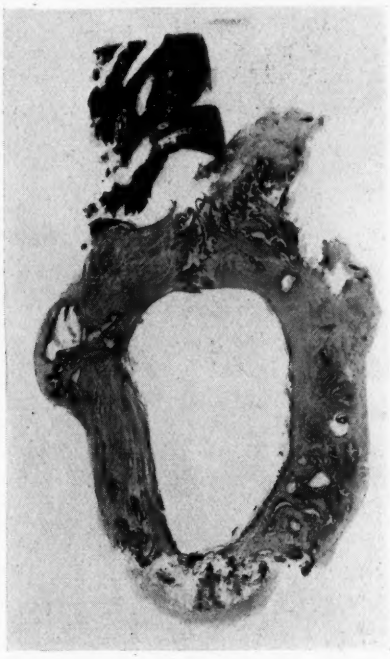


FIG. 378.—*Case* 23.

Genkin and Dmitruk[4] experimented with 19 rabbits, introducing various foreign bodies (human gall-stones, pieces of pumice or of tile) into the gall-bladder. The foreign bodies were in some cases sterile and in others infected. The results were comparable with those obtained by the previous authors in guinea-pigs, except that in no case was there any indication of a malignant growth. Six of the animals survived four years after the initial operation and were then killed. The experimenters remark that as much papillomatous and adenomatous growth was found in the animals which died soon after the operation as in those which survived a long time.

Early in 1930, at the suggestion of the late Professor Leitch himself, the writer undertook to repeat this type of investigation, and biliary calculi were inserted into the gall-bladders of 47 guinea-pigs.

Technique.—A suitable area of the abdomen having been epilated, the guinea-pig was anæsthetized and the gall-bladder was exposed through a

paramedian incision made to the right of the xiphisternum. The gall-bladder having been opened between two clips applied to its wall, one or two calculi were inserted through the aperture so made. Closure was effected by rotating one clip around the other, so as to produce a twist of two turns, and then applying a fine catgut ligature. By this method no extraneous suture material was introduced into the viscus, nor did any inverted ridge of cut membrane remain within its cavity. The wounds healed well without leakage of bile, and the animals did not appear to suffer from any immediate ill effects after the operations.

FIG. 379.—*Case* 24.

The gall-stones used were of two kinds, and were derived from non-malignant human cases. Gall-stones 'A' were tetrahedral, faceted, clean cholesterol stones weighing between 50 and 100 mgrm. each. They were placed in methylated spirit prior to use. Gall-stones 'B' were smooth, irregularly faceted stones, which were opaque white on the surface and reddish-brown within, and were friable. They had been removed from a patient who had suffered from symptoms of cholelithiasis accompanied by thickening and fibrosis of the wall of the gall-bladder with some destruction of its mucous

FIG. 380.—*Case* 25.

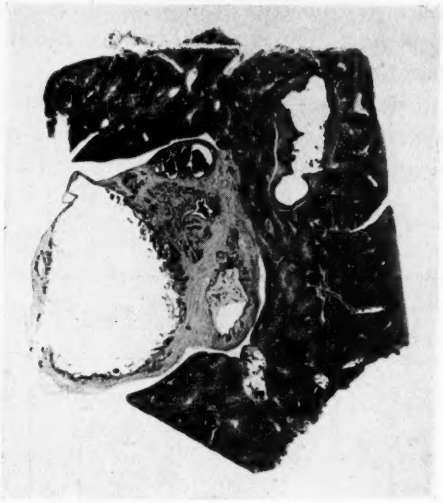


FIG. 381.—*Case* 26.

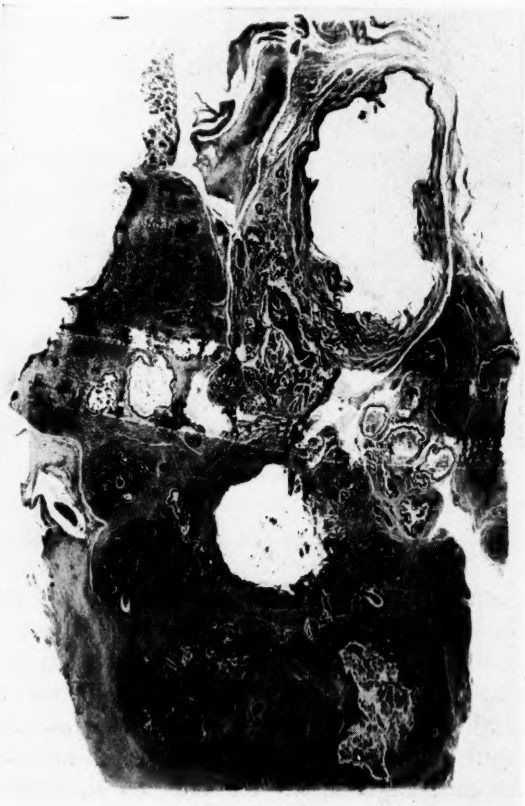


FIG. 382.—*Case* 27.

FIG. 383.—*Case* 28.

lining, no carcinoma being present. Usually only one of these stones was inserted, but this was sometimes broken into two or more fragments during insertion. These calculi were sterilized in the autoclave together with the dressings.

Results.—Some of the animals, owing to death in the early stages of the experiment, or because they died in the night and became too decomposed for satisfactory examination, or for other reasons, are not available for this

Table II.—Summary of the Author's Own Experiments.

	Sex	Number of Stones Inserted	Kind of Stone used	Life after Operation	Cause of Death
				Weeks	
1	F.	1 (broken)	B	9	Not recorded
2	F.	1	B	11	Pneumonia
3	F.	1	B	17	Intestinal obstruction (adhesions)
4	F.	1	B	18	Not known (animal emaciated)
5	F.	1	B	27	Killed
6	M.	1	B	27	Killed
7	F.	2	B	27	Killed
8	F.	1	B	27	Killed
9	F.	1	A	27	Killed
10	F.	1	B	30	Killed
11	F.	2	A	30	Killed
12	F.	1	B	34	Pneumonia
13	F.	1	A	36	Killed
14	F.	1	A	36	Killed
15	M.	1	B	36	Killed
16	F.	1	B	36	Killed
17	F.	1	B	38	Killed
18	F.	1	B	46	Bronchopneumonia
19	M.	1 (broken)	B	54	Biliary sepsis
20	F.	1	A	61	Biliary obstruction
21	F.	1	A	73	Not recorded
22	F.	1	A	75	Pneumonia
23	F.	1	A	82	Nephritis
24	F.	1	A	91	Pneumonia
25	F.	1	A	93	Not recorded
26	F.	1	A	98	Not recorded
27	M.	1	B	98	Tuberculosis
28	F.	1	B	123	Nephritis
29	F.	1	A	128	Nephritis
30	F.	1	A	153	Nephritis
31	F.	1	A	154	Nephritis
32	F.	1	A	—	Still alive
33	M.	1	A	—	Still alive

report. There remain 33 whose after-history can be accurately followed (*Table II*). Not one of these animals has succumbed to cancer, and no cancer has been found microscopically. Two of the animals are still alive and well nearly three years after introduction of the gall-stones. In every case examined after death—31 in all—a condition of hyperplasia has been present in the gall-bladder. Although varying as between one individual and another in minor characteristics and degrees, the changes found conform

to those described so admirably in this JOURNAL by King and MacCallum[10] as occurring in cases of human cholelithiasis, under the title of " Cholecystitis Glandularis Proliferans (Cystica) ". In this respect my results agree with those of every other experimenter (*Figs.* 356–384).

FIG. 384.—*Case* 29.

The changes may be expressed as follows. The gall-bladder, which in the guinea-pig is normally almost free from the liver (*Fig.* 385), becomes adherent to it by newly formed connective tissue so as to appear in some instances completely embedded (*see Figs.* 358, 365, 369). The resultant mass is hard to the touch, often shows rounded bosses, is dead white, and without sharply defined outlines. Owing to these features the condition may readily be mistaken macroscopically for a malignant growth. Such remarks can be applied equally to man. *Fig.* 386 is a photograph of this benign condition as represented by a specimen of human origin in the museum of the Cancer Hospital, and it shows well how closely the condition may simulate cancer when viewed with the naked eye. In *Fig.* 387, which is taken from a microscope slide of this specimen, the condition will be seen to correspond with

that which occurs in guinea-pigs under the experimental conditions now being discussed. Microscopical examination of the lesions produced in the animals reveals extensive proliferation of the fibrous, muscular, and glandular elements of the gall-bladder. The hyperplastic epithelium projects into the cavity of the viscus to form papillomata (*see Figs.* 373, 376), grows outward through the muscular bundles, forming subperitoneal adenomata where the gall-bladder is free (*Figs.* 378, 388), and invading the liver where the two organs are joined together by newly formed connective tissue (*see Figs.* 358, 365). In these protrusions cystic dilatations are very frequent and the epithelium is often atypical (*Fig.* 389). Along the surface where the liver and the newly formed

FIG. 385.—Gall-bladder from a normal guinea-pig.

connective tissue of the gall-bladder come into contact there are seen many small bile-ducts (*Figs.* 390, 394) in which the arrangement of epithelium may be disordered and suggestive of an early malignant change.

DISCUSSION.

The general character of the results obtained in all the experiments by the different observers mentioned above is uniform—that is to say, the introduction of a foreign body into the gall-bladder of a guinea-pig or a rabbit produces at a very early stage a rapid and extensive proliferation of the various histological elements composing the affected viscus. Moreover, this proliferation is accompanied by a penetration into the contiguous structures—for example, the liver and adherent omentum—of the newly formed glandular

and other elements derived from the gall-bladder (*see Fig.* 392). This invasive process has led to varying interpretations by individual workers, some having accepted it—especially when accompanied by the development of atypical epithelium—as evidence of malignancy, while others have regarded this kind

FIG. 386.—Cholecystitis proliferans in man. Photograph from specimen No. 1322 in the Museum of the Cancer Hospital (Free), London.

of invasion as compatible with innocence. Some have avoided a final decision by referring to the conditions as precancerous. As will be seen below, the writer does not believe that the microscopical evidence hitherto brought forward to support the view that cancer has been produced artificially by

gall-stones is impeccable. However that may be, the diagnosis of cancer in experimental work with animals requires further proofs than those supplied by the microscope. The tumour should infiltrate and destroy the neighbouring structures, it should be amenable to transfer by autografts or heterografts, it should form metastases, and, unless treated, it should progress so as to kill the host. Not all these tests are essential to a diagnosis of malignancy, but at least some of them should be fulfilled. In the experimental work now under consideration not one of them can be used to substantiate the diagnosis of cancer. Even the protrusion of newly formed glandular elements from the inflamed gall-bladder into the liver (*see Fig.* 392), though described as

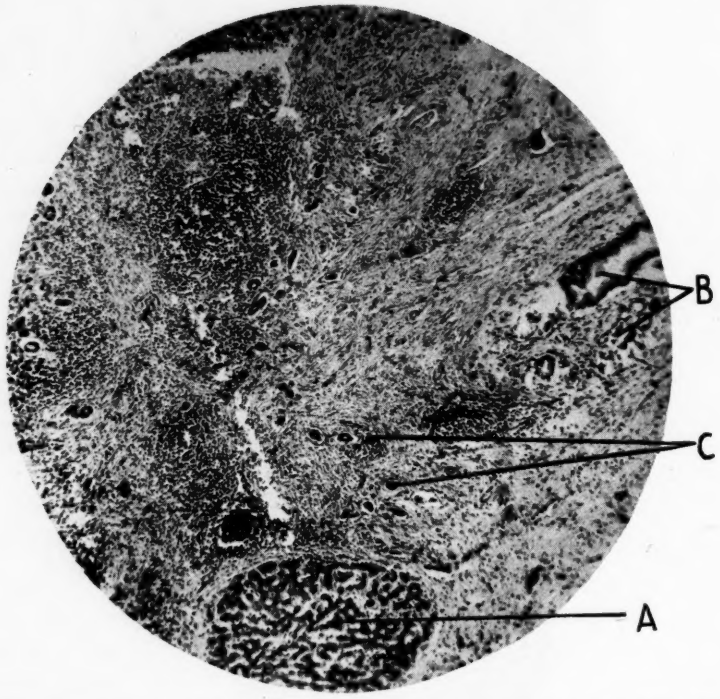


FIG. 387.—Microscope section taken from specimen illustrated in *Fig.* 386. The main ground is granulomatous. An isolated group of liver cells (A) is shown in addition to adenomatous tissue (B) derived from the gall-bladder, and numerous small ducts (C) probably originating from the liver.

'invasion', differs in character from the infiltrative and destructive ingrowth of malignant disease. It appears to be preceded by a fibroblastic development, the protrusion of glandular epithelium being confined to the granulation tissue.

The absence of any successful grafting of the tumours in the experiments described above is significant. Kazama seems to have been the only experimenter to make such an attempt, and his efforts did not succeed. The failure or omission of this important test appears inexplicable unless one is to assume either that the tumours were innocent or that neoplastic growth of sufficient bulk was not available—a lack which in itself might cast a doubt on the diagnosis. Kazama is the sole inquirer amongst those quoted who states

that he has seen metastases. Unfortunately his paper is not illustrated. In one case he claims to have produced cancer with metastasis within the astonishingly brief period of seven weeks.

Concerning the lethal nature of the condition produced, it is noteworthy that among the 268 animals into whose gall-bladders foreign bodies have been introduced by the various workers (*Table III*) in the foregoing experiments

Table III.—Results of Inserting Foreign Bodies into the Gall-bladders of 268 Animals.

Author and Year of Publication	Animal used, and Number	Foreign Bodies used	Maximum Duration of Life after Operation	Number Free from Cancer	Number with Cancer	Cancer with Metastasis	Survivors in which Ultimate Result has not been recorded
			Months				
Kazama, 1922	Guinea-pig 98	Gall-stones Suture material Mucous membrane Pityrol Lanolin	5½	72	26	9	—
Leitch, 1924	Guinea-pig 35	Gall-stones Pebbles Pitch pills	12	27	8	0	15
Clemente, 1927	Guinea-pig 20	Pills of cement and tar	3½	20	0	0	0
Delbet and Godard, 1928	Guinea-pig 16	Gall-stones	19	14	2 ?*	0	0
Petrov and Krotkina, 1928	Guinea-pig 30	Gall-stones Paraffin Coal tar	20	30	0	0	0
Gioia, 1929	Guinea-pig 17	Pebbles Pumice and tar	23	?	? †	0	0
Genkin and Dmitruk, 1932	Rabbit 19	Gall-stones Pumice Tile fragments	48	19	0	0	0
Burrows, 1932	Guinea-pig 33	Gall-stones	38½	33	0	0	2‡

* In two cases there were appearances suggestive of cancer. † In some cases the microscopical changes could be regarded as precancerous or as early cancer. ‡ These animals are still alive.

not one is recorded to have died of cancer. If, as stated in Kazama's and Leitch's papers, malignant tumours were in fact brought about within a period of two to six months, it is difficult to explain why none of the animals died of the disease, seeing that many of them survived after operation for periods much longer than six months. Apparently it must be assumed either that the diagnosis of cancer was at fault, or else that only those animals having cancer already happened at an early stage to succumb to some intercurrent

condition or, though seeming to be well, to have been sacrificed deliberately. The latter alternatives are so improbable as to be hardly acceptable.

From these arguments it is clear that the only basis for supposing cancer to have been produced by inserting foreign bodies into the gall-bladder, is the appearance seen in certain microscope sections taken from animals whose deaths could not in any way be attributed to the presence of cancer. It remains to be seen how far these sections are to be relied upon. Creighton[11] called into question the diagnosis of malignancy as shown by the illustrations of Leitch's paper, and the present writer has not yet seen a microscope section or an illustration which convinced him that the condition of the gall-bladder brought about by the experimental introduction of foreign bodies was in fact

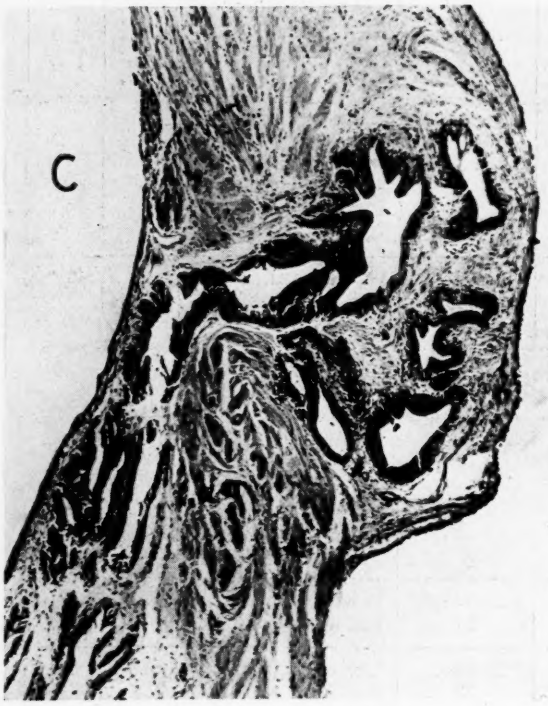


FIG. 388.—*Case* 9. Part of the wall of the gall-bladder. A glandular protrusion has grown through the hypertrophied muscle to form a subperitoneal adenoma. C, Cavity of gall-bladder.

malignant. Certain fallacies occur in the particular circumstances under consideration. The first is the ingress of glandular protrusions derived from the gall-bladder into the liver and other adherent tissues. This 'invasion', as remarked above, always appears to be preceded by freshly formed fibroblastic tissue to the region of which the glandular proliferation is confined (*see Fig.* 392). In this respect the condition differs essentially from a malignant invasion. The ingrowths of fibroblastic tissue, whether containing epithelial cells or not, may cause the isolation and destruction of small groups of hepatic cells (*Figs.* 387, 393). The presence of such isolated masses of parenchymatous cells in itself seems to have been regarded as evidence of malignancy

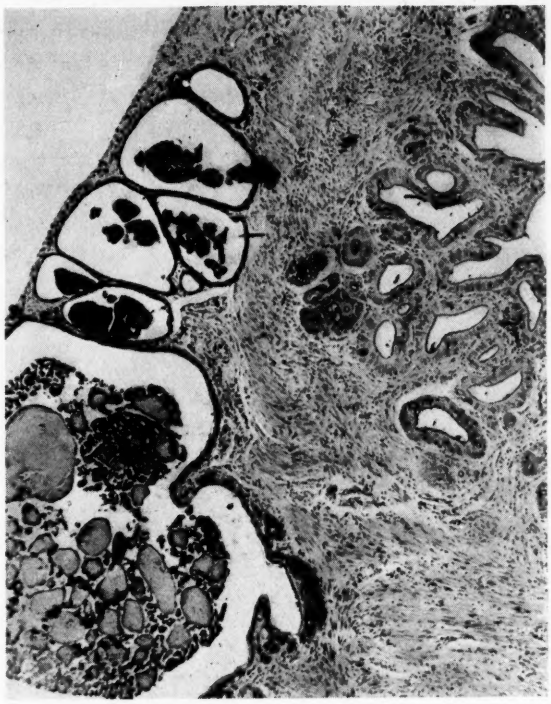


FIG. 389.—*Case* 12. Shows general hyperplasia of wall of gall-bladder with formation of cystic adenoma.

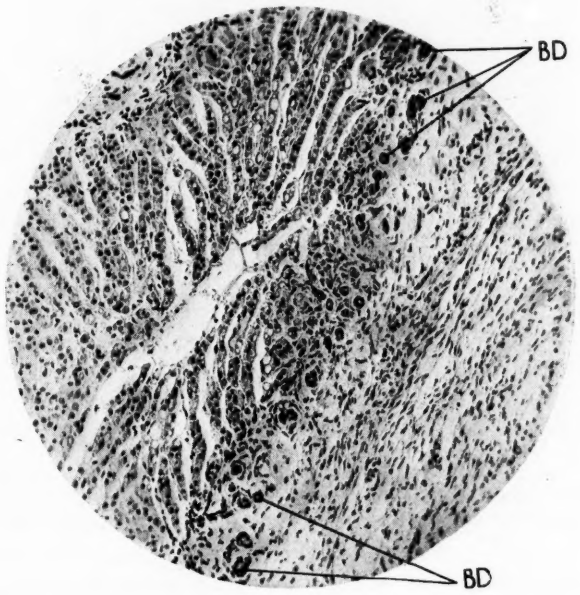
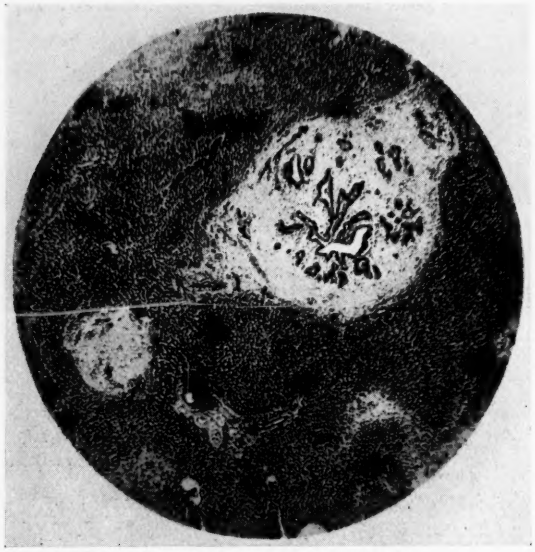


FIG. 390.—*Case* 26. Illustrates proliferation of small bile-ducts (BD).

(see Leitch). However, this permeating or, as it might be termed, infiltrating fibroblastic response to irritation of the gall-bladder can hardly be mistaken for anything but an innocent condition. Any misunderstanding that has



FIGS. 391, 392.—*Case* 3. Illustrate an ingrowth into the liver of fibroblastic tissue containing glandular epithelium derived from the gall-bladder. In *Fig.* 391 a so-called 'islet' is shown, which serial sections prove (*Fig.* 392) to be continuous with the gall-bladder.

arisen in this respect must be attributed to the fact, already mentioned, that proliferating glandular epithelium derived from the gall-bladder is apt to extend along these fibroblastic processes and so to form simple protrusions

or compound ramifications of adenomatous looking tissue within the body of the liver. This intruded glandular tissue frequently becomes cystic. In single microscope slides 'islets' of such proliferating glandular tissue may be seen in the liver substance accompanied, it may be, by so-called cysts. Such islets have been mistaken for deposits of adenocarcinoma, though serial sections demonstrate that they are in reality adenomatous protrusions from the gall-bladder with which they are in direct continuity (*Figs.* 391, 392).

Another source of error is the formation by the liver of new bile-ducts in response to irritation. The phenomenon is recognized in connection with acute yellow atrophy and hepatic cirrhosis, and can be seen in many of the microscope sections of a chronically inflamed gall-bladder in contact with the liver (*Fig.* 390). These ducts, originating from the liver, and becoming

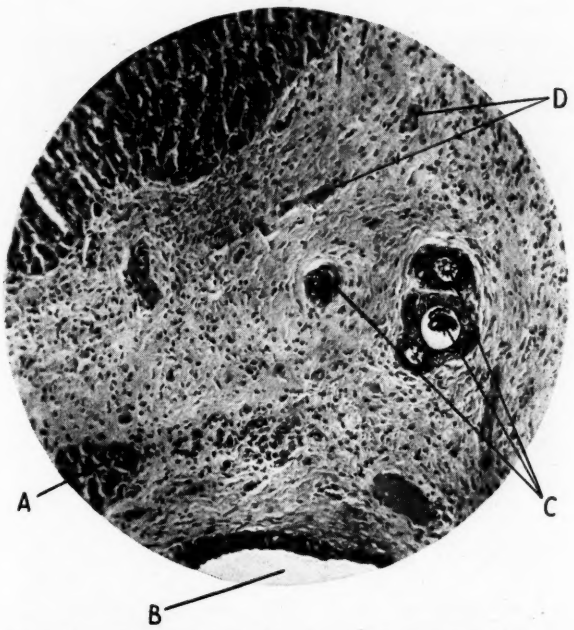


FIG. 393.—*Case* 10. Shows an isolated group of liver cells (A), adenomatous cyst (B), proliferated glandular epithelium from the gall-bladder (C), and ill-formed bile-ducts (D) derived either from the liver or the gall-bladder.

associated with proliferating glandular epithelium from the gall-bladder which also is sprouting into the newly formed fibroblastic tissue in and about the liver, may be misinterpreted as derivatives of the gall-bladder invading the liver.

In *Fig.* 394 is shown a thin adhesion between the gall-bladder and liver (*Case* 25, *Table II*). At the hepatic end of the adhesion a small area of granulation tissue is seen encroaching on the parenchyma of the liver, and in this granulation tissue, close to the hepatic cells, is seen a small mass of proliferating bile-duct epithelium, presumably derived from the liver. Serial sections taken through a considerable extent of this adhesion fail to show a direct connection between these new bile-ducts and the glandular elements of the gall-bladder in the neighbourhood. The absence of any adenomatous

encroachment from the gall-bladder in the neighbourhood of the adhesion to complicate the picture in this specimen renders the hepatic origin of these newly formed ducts almost if not quite convincing.

To the foregoing criticisms of past experimental work some supplementary comments of a more general nature may be added. Among them is the curiously short period in which the supposed experimental cancers arose. Thus Kazama claimed to have produced two cases of carcinoma, one of them with metastasis, within a period of seven weeks, and the maximum duration of his experiments seems to have been five and a half months (*see Table I*); and Leitch reported the production of carcinoma in five cases within six months. These periods are suspiciously short for the induction of cancer in the guinea-pig by artificial means.

FIG. 394.—*Case* 25. A thin adhesion connects the gall-bladder with the liver. At the hepatic end of the adhesion is a small area of granulation tissue, in which, close to the liver, are numerous small bile-ducts (*see text*).

Another point is this: all the experimenters to whom reference has been made above have obtained the same results whatever foreign body they have used, whether gall-stones or other material—that is to say, the outcome has been the consequence of a non-specific irritation. But it is recognized that cancer is an infrequent result of non-specific irritation as applied to laboratory animals other than the guinea-pig.

The experiments on which this paper has been founded call to mind the somewhat similar procedure carried out by Pack and Buzzanca,[12] who inserted sterile pebbles into the renal pelves of rabbits and thereby produced epithelial hyperplasia and papillomatosis. No malignant disease occurred, but the

longest post-operative survival was only 177 days, and it is conceivable that cancer might have supervened if the rabbits had lived longer.

In conclusion, it appears that laboratory experiments up to this date have failed to establish a causal relationship between the presence of calculi in the gall-bladder and the occurrence of cancer in this organ. Further experiments are in progress and the results will be reported.

SUMMARY.

1. Gall-stones inserted into the gall-bladders of 33 guinea-pigs did not produce cancer.

2. Previous experiments by other investigators have been analysed in view of these results, and are held to be in accord with them.*

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* Since this paper was written Petrov and Krotkina[13] have recorded the results of some further experiments. They used 19 young guinea-pigs, inserting glass tubes containing radium into the gall-bladders of 12, and glass tubes without radium into the gall-bladders of 7. They state that after periods of 136 and 158 weeks respectively carcinoma was found in 2 of the animals which had been treated with radium, while of the guinea-pigs treated with plain glass tubes, adenocarcinoma with metastases occurred in 2—in the 66th and 166th weeks of the experiment.

POLYORCHIDISM.

By R. HODGSON BOGGON,

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Polyorchidism is a condition which always has excited considerable interest from legendary to scientific times. In the old days a large number of cases were described, and those blessed with this numerical curiosity were thought to be greatly favoured and possessed of supervirility. Lucas-Championnière discoursed on the subject in a lecture in 1900 and stated that Ambrose Paré, as well as many other surgeons of that period, believed multiple testes to be not infrequent. Cases of three, four, or five testes were recorded, and authors appeared to compete one with another in the number of testes in each case described, and in fact a new nomenclature was evolved. Arnaud in the eighteenth century apparently believed most unusual stories. He quoted the case of a man endowed with polyorchidism who practised coitus up to the age of 125 years and other instances of men able to repeat the act twenty-five to thirty times in one night. When reduced to fact the only authentic example of the condition in early days is confined to a post-mortem by Blasius in the seventeenth century on a patient with three testes.

With the advent of scientific times and more critical investigation the number of cases has rapidly diminished. Only those should be accepted in which the 'supernumerary testis' is submitted to histological examination, for there are many other conditions, such as a cyst of the cord or a floating epididymis, which may be mistaken for it.

Edington and Blacklock in 1928, in a careful investigation of the literature, were able to find only eight cases (to which they added one), that were submitted to microscopical examination. King in 1931 reported an additional example and mentioned also a post-mortem case of Ahlfeld's. In view, therefore, of the rarity of the condition it is desirable to put this, the twelfth, case on record, especially as it was associated with recurrent torsion of one of the testes. The following are the notes of the case :—

CASE REPORT.

History.—Male, age 23. Baker by trade. Married and has one child. In 1928 he was operated upon successfully for a thyroglossal fistula. No other relevant previous history. For the five years previous to admission the patient experienced temporary swelling and acute pain in the left side of his scrotum. These attacks occurred about twice a year and lasted several hours. The last attack was eight months before admission. Typically the attack occurred suddenly without any warning, and the patient was unable to say what brought it on. During the attacks the pain was very severe and radiated up into the left groin, the left testicle at the same time becoming swollen and very tender. The termination of an attack was fairly abrupt and the swelling soon subsided.

On Examination.—The patient is a man of sallow complexion and poor physique. On his neck is the scar of the healed thyroglossal fistula operation. On

examining his scrotal region it was noticed that the right testicle hung lower than the left and appeared on palpation to be of normal size and in a normal position. In the left side of the scrotum, however, there were two small ovoid bodies, one about twice the size of the other. The larger of the two lay at the bottom of the scrotum and was about 1 in. in diameter. It gave no testicular sensation on pressure. One and a half inches above, and placed somewhat antero-laterally, lay the second swelling, which did not appear to be so definitely round as the lower one and was similarly devoid of testicular sensation. Between the two, and joining them, could be palpated a soft tape-like structure, and above, leading up to and through the external abdominal ring, the vas with its accompanying structures. The provisional diagnosis was imperfectly descended testicle with separation of the epididymis from the body of the testis, the symptoms being due to recurrent torsion.

Operation.—Under general anæsthesia operation was carried out on July 15, 1931, by Mr. Maybury. A left inguinal incision was made and the inguinal canal

Fig. 395.—The specimen after dissection.

opened by cutting through the external oblique aponeurosis. The spermatic cord was pulled upon and the left scrotal contents were delivered into the wound. It was then found that the two solid structures had the appearance of two testicles enveloped in tunica vaginalis. A band of tissue ran down from the external ring to both, and owing to this it was thought that the vas divided. When the tissue was dissected at a later date it was found that the band to the larger testis consisted only of vessels. In view of the recurrent acute symptoms for which the operation was being performed and the fact that the testicles were small and imperfectly developed (as evidenced by the lack of testicular sensation), it was considered advisable to remove them. As there was no evidence of a hernial sac, the cord was ligatured and divided by the internal abdominal ring and the testicles were removed. There was no evidence of a gubernaculum. The patient made an uneventful recovery and was discharged on July 22.

Macroscopic Description.—The tissue removed at operation was preserved and dissected at a later date (*Fig.* 395). It consisted of two ovoid bodies of unequal

size, both enveloped in tunica vaginalis, which extended up to near the external abdominal ring. Lying at the lower end of the mass was a small quantity of fibro-fatty tissue, which might be the remains of the gubernaculum, for otherwise there was no evidence of this structure. The two ovoid bodies on section proved to be testicles. The smaller of the two measured 1·5 × 1·25 cm. Running down to it from the external abdominal ring was the cord consisting of the vas together with its vessels. The vas was tortuous near this smaller testis, and, where it was connected to its outer side, became very narrowed and coiled like an epididymis.

The larger testis lay about 5 cm. below the smaller and somewhat to the inner side. It measured 2·5 × 2 cm., and was connected by a structure which on dissection had the appearance of an epididymis. This epididymis was 7·5 cm. long with a width of 5 to 6 mm. and a thickness of 4 mm., and joined the larger testis at its upper pole. The tunica had to be carefully dissected away to reveal its structure.

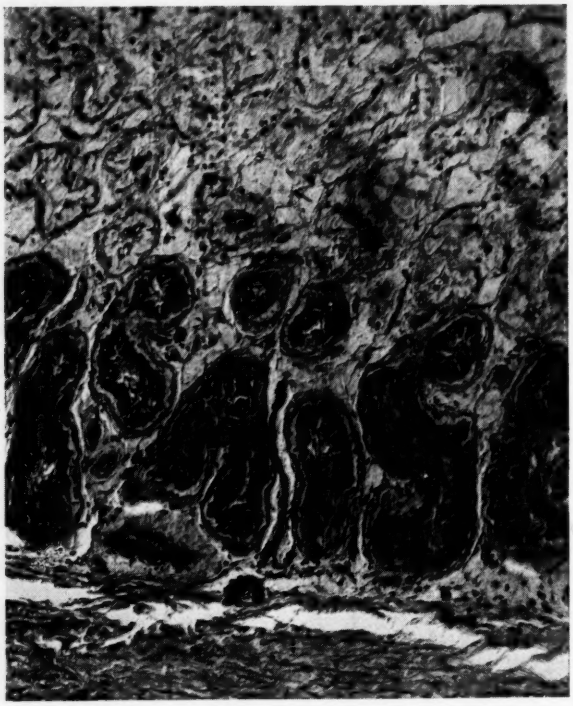

FIG. 396.—Microphotograph of a section of the larger testis.

The vessels ran down in relation with the vas, and on reaching the smaller testis gave off a branch which ran at first along the upper border of the epididymis, then for a short course upwards in the scrotum, again to the epididymis, and reached the larger testis. From the upper border of this testis another mesh of vessels ran upwards and somewhat posteriorly to join the cord just below the external abdominal ring.

MICROSCOPIC DESCRIPTION.—The larger testis is surrounded by a thick fibrous capsule (*Fig.* 396). Internal to this there is evidence of massive necrosis followed by organization. The tubules have to a large extent disappeared and are replaced by fibrous tissue. Here and there remain a few tubules which show no evidence of spermatogenesis. The interstitial cells of Leydig can be seen clearly and the cells of Sertoli are just demonstrable (*Fig.* 397). In other areas the fast disappearing tubules are seen as indistinct outlines in a matrix of fine fibrous tissue. New capillary vessels are visible and the old vessels show hyaline degeneration of their

walls. Small areas of old hæmorrhage with pigment-granules are scattered about in the fibrous tissue.

FIG. 397.—High-power view of a tubule from *Fig.* 396.

The small testis has a well-marked fibrous capsule. It contains a large number of tubules, many more than in the larger testis, but of a poorly developed type,

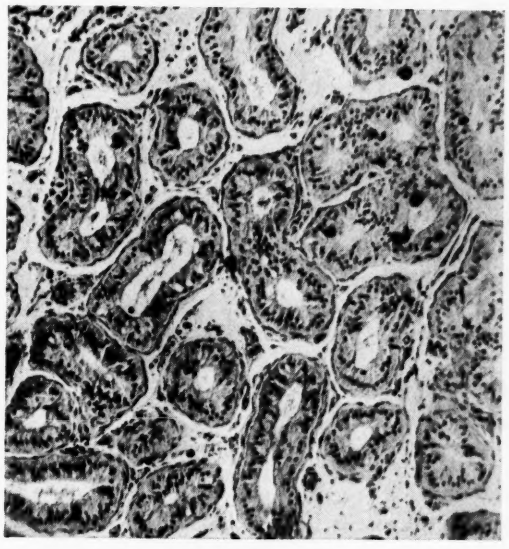

FIG. 398.—Microphotograph of a section of the smaller testis.

and in some places there is evidence of degeneration (*Fig.* 398). Spermatogenesis was not taking place, although the tubule-cells have stained more darkly than

normal (*Fig.* 399). The interstitial tissue contains in addition to fibrous tissue many cells of Leydig. The scattered blood-vessels are normal in appearance.

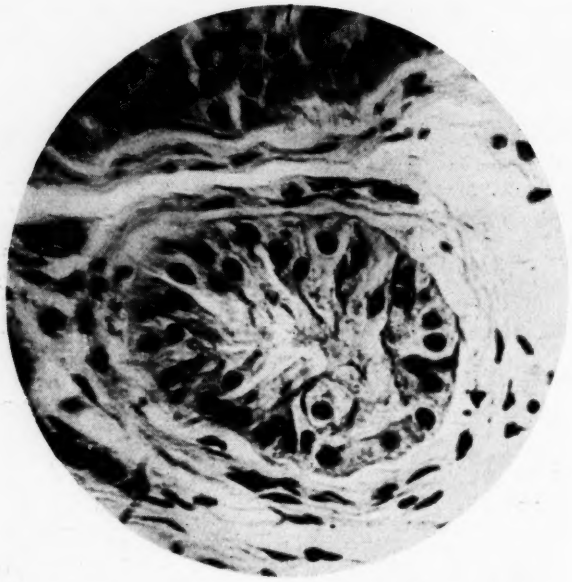

FIG. 399.—High-power view of a tubule from *Fig.* 398.

The elongated epididymis between the two testicles consists of loosely packed tubules (*Figs.* 400, 401). These tubules are lined by two layers of epithelium, the nuclei of which stain a great deal more darkly than normal. The cells of the

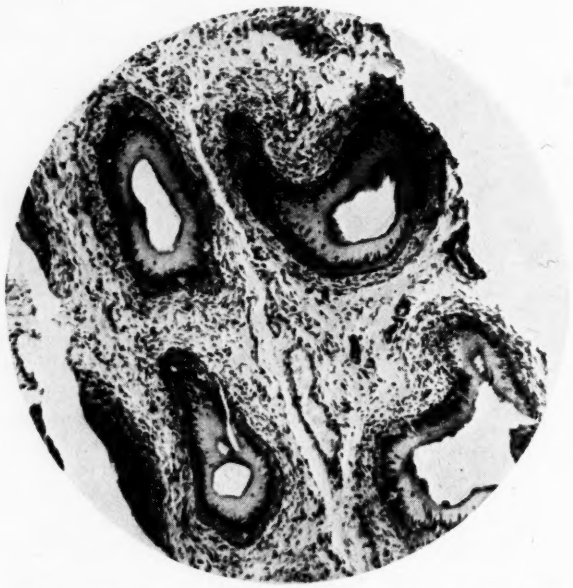

FIG. 400.—Microphotograph of a section of the epididymis in relation to the larger testis.

basal layer are small, dark, and cubical, while those of the other layer are columnar and less deeply staining with basal nuclei. The stereocilia are normal and the

lumen is completely empty of spermatozoa—good evidence of the non-activity of the larger testis. In the intertubular space are fibroblasts and fibrous tissue, but the latter is considerably denser immediately adjacent to the tubules than normal. The blood-vessels are dilated. Deposits of fat in the fibrous tissue (shown up by staining with Scharlach R.) indicate a degenerative process. The vas is normal in its histological structure (*Fig* 402).

FIG. 401.—Microphotograph of a section of the epididymis in relation to the smaller testis.

DISCUSSION.

The points of interest in this condition, besides its rarity, relate to the factors concerned in the production of the abnormality, and its association with torsion. Arbuthnot Lane in 1895 was the first to record an example of polyorchidism that was proved by operation and histological examination, although Ahlfeld's specimen found at post-mortem is of earlier date.

The specimen here described appears to be identical in principle with those described by Lossen, Edington, and King—namely, two testes with a single vas and an epididymis stretched out in such a way as to serve them both. In Lossen's and Edington's cases, however, the vas arose from the epididymal structure in relation to the larger testis.

In order to explain the mode of production of the two testicular bodies, it is necessary to outline briefly the normal embryological changes. The testis develops from the genital ridge, a longitudinal thickened fold on the inner surface of the Wolffian body (*Fig.* 403, A). The germinal epithelium of the middle third of this ridge invades the subjacent mesoderm to form the sex cords and ultimately the seminiferous tubules. The rete cords most

probably arise from the germinal epithelium of the anterior portion of the genital ridge, while the vasa efferentia are derived from the anterior part of the mesonephros, or Wolffian body (*Fig.* 403, B). The epididymis and vas deferens arise from the Wolffian duct. During development the anterior seminiferous tubules disappear and new tubules are formed, more caudally. In this particular form of double testis it is suggested that this disappearance of tubules is at fault, so that they disappear in the middle of the genital ridge only, while anteriorly they persist (*Fig.* 403, C). This would explain the common epididymis and vasa efferentia to both testes. King states that in his opinion the abnormality is due to transverse division of the genital ridge. In his case there was a well-marked gubernaculum, which on section showed smooth muscle and fibrous tissue, attached to the upper and larger testis,

FIG. 402.—Microphotograph of a section of the vas deferens.

which arose from the cephalic end of the genital ridge. He endeavours at some length to explain this method of descent, and I have similarly attempted to show by means of diagrams how descent may have occurred in the case reported here, although there was no evidence, as far as can be ascertained, of a definite gubernaculum. It is inferred that in the developmental position the larger testis was in the uppermost or cephalic position and to it the termination of the epididymis is attached. The artery to this testis should be the shorter, as the latter is nearer in its origin from the aorta. In the descent into the scrotum (*Fig.* 404, A) the larger testis, having the gubernacular attachment, descends so as to become the inferior organ (*Fig.* 404, B).

Spermatogensis is described as occurring in at least six of the cases in the literature, and from the accounts it seems probable that this degree of development depends partly on the size of the testis and partly on the distance travelled from the intra-abdominal position. In this specimen there

was no evidence in spite of the size and descent of the organs. This may be explained in the larger testis by the recurrent twistings to which it was subjected and which interfered with its normal physiological activity. In the rest of the records there is either no mention of the functional condition, or spermatogensis was not present.

In some cases the abnormality was of a different type, the supernumerary organ having a separate vas (Lane, Haas), while in several others (Lerat, Mariotti, Lecène) a separate cord was described, which may or may not have included a vas. It is difficult to be sure on this point without careful dissection, as in the case described here there appeared at first sight to be two vasa, one of which was shown later to consist of a leash of vessels only.

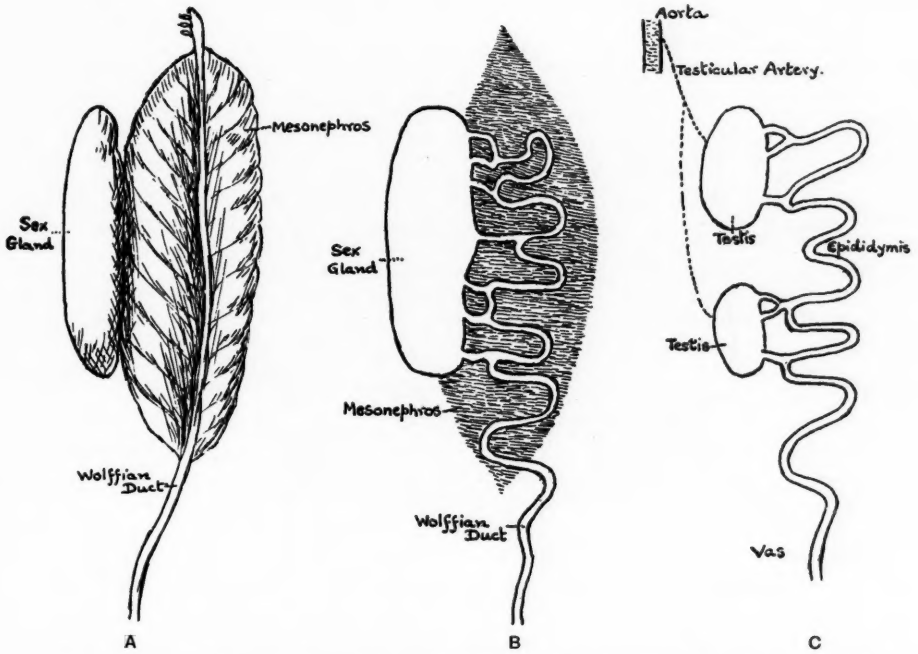

FIG. 403.—A, Diagram illustrating the position of the undifferentiated sex gland; B, Diagram showing the formation of the body of the testes, vasa efferentia, epididymis, and vas deferens; C, The formation of the two bodies of the testes.

A duplication of the vas appears to be associated with a more marked cleavage of structures in the region of the mesonephros during the process of development.

It is convenient to mention here what is termed by Edington and Blacklock 'pseudo-duplication', as it can be easily confused with true polyorchidism. Cases are reported by Marsh, Banks, and Lowe. In Marsh's specimen two testes were present in the left side of the scrotum, while the right side was empty. Two vasa ran from the testes and joined to form a common duct, while the right spermatic artery, arising normally, crossed the mid-line to supply one of the testes, after joining the left artery.

The preponderance of left-sided cases is striking, for of the 12 recorded no fewer than 9 were on this side. The explanation is hard to find.

The occurrence of recurrent torsion is interesting, and the evidence for it does not leave much room for doubt. The recurrent and sudden attacks of acute pain and swelling were the cause of the man's applying for treatment, and it is more than likely that if these symptoms had been absent, this specimen would never have been obtained. The necrotic destruction of the tubules seen on section, with the evidence of organization, indicate a history of some length. In the cases subjected to microscopy there is not one record of torsion, although Holder's example might be considered. His patient was admitted with four days' acute pain and swelling in the left inguinal region. A diagnosis of suppurative adenitis was given and an incision made. A testis was found which, on being examined microscopically, showed

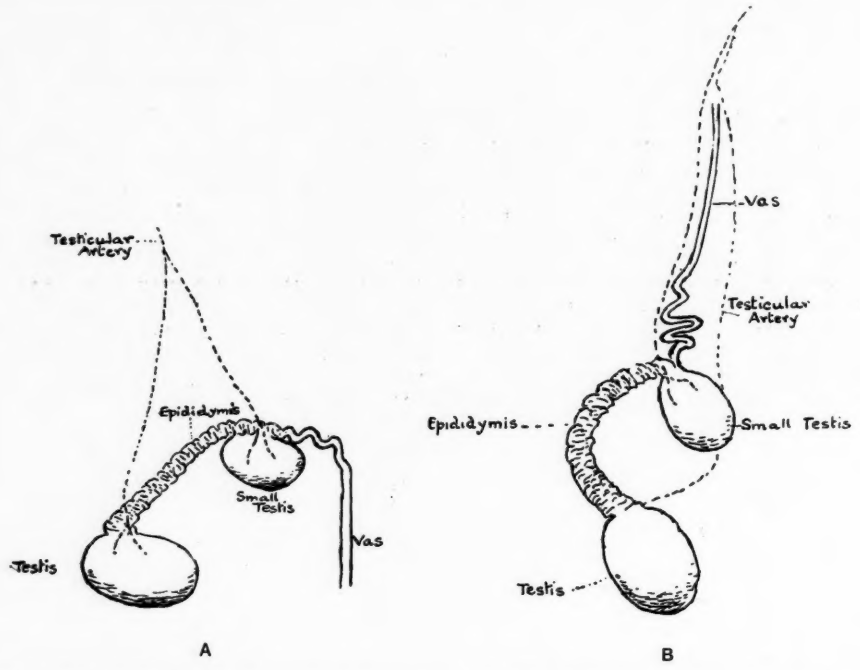

FIG. 404.—A, The early descent of the organs; B, The final descent into the scrotum.

active spermatogenesis with a condition of acute inflammation. From these data it is probable that the correct diagnosis was acute inflammatory orchitis. Coudert and Derocque described a case which can hardly be included in this series, as no description of the section was published. This patient was a child of seven months, admitted with the symptoms of a strangulated inguinal hernia, and was operated upon by Derocque. At operation in the inguinal region he found a tumour exactly like an acute torsion of testis, while below in the scrotum lay a normal testis. The twisted organ arose from the cord by a pedicle and appeared to have an epididymis. If this was a case of polyorchidism, then it is the only other example of such an anomaly associated with torsion.

The causation of torsion is still largely speculative, but the well-recognized etiological factors of imperfect descent and formation were present in this

case, and the possible factor of complete envelopment by tunica vaginalis as put forward by Muschat may also have assisted.

I am indebted to the late Sir Percy Sargent and Mr. Maybury not only for permission to publish the records of this case but also for their kind advice; to Professor le Gros Clark and Dr. D. C. L. Derry for generous assistance in the anatomical and pathological details respectively; and to Mr. F. E. Bloss for so ably preparing the microphotographs.

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CARCINOMA OF THE MALE URETHRA.

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THE case of carcinoma of the male urethra reported here is worthy of record not only because of the rarity of the condition, but also because the growth was situated in the fossa navicularis, an uncommon position. In addition, the extremely early diagnosis and treatment of the patient are of interest. Up to 1929 Huggins and Curtis were able to collect only 110 cases from the records in which there was but little doubt of the diagnosis. Since then a few more have been put on record, mostly in the foreign literature.

The first example of carcinoma of the urethra to be published was described by Thiaudière in 1834, but subsequently Kaufman has thrown some doubt on the diagnosis. Robb notes the interesting fact that up to 1928 there was no specimen of this condition in the museums of either the Royal College of Surgeons of London or Edinburgh. No doubt this is due in part to the fact that early cases are rarely seen, but it is largely because the majority of urethral carcinomata originate in the membranous and bulbous urethra, where invasion of surrounding tissues prevents removal in the form of a specimen.

The following are the notes of a case admitted to St. Thomas's Hospital under the care of the late Sir Percy Sargent, to whom I am indebted for permission to publish these details.

HISTORY.—Male, age 60. In his youth he had suffered from both gonorrhœa and syphilis, but did not develop a urethral stricture. For years he had suffered from epileptic fits, which were controlled by luminal. Three months before admission he noticed a slight bloody discharge from the external urinary meatus, and this drew his attention to a small nodule on the under surface of his penis.

ON EXAMINATION.—A hard nodule about the size of a split pea was felt on the under surface of the glans penis in the line of the urethra and about one inch from the external meatus. The tumour was subcutaneous, and when squeezed a drop of bloody discharge exuded from the urinary meatus. In the right inguinal region two rubbery and movable glands were felt. The general condition of the patient was poor. A provisional diagnosis of carcinoma was made and it was decided to explore the urethra in order to verify this.

OPERATION (Feb. 17, 1932).—An operation was carried out under general anæsthesia. The floor of the urethra was split open from the external meatus to the site of the tumour, which consisted of a small ulcer with an indurated base and edge. This was considered to be malignant. In view of the uncertainty of the results of treatment by radium, it was decided that a conservative

amputation should be performed. The penis was therefore removed from in front of the scrotum, using a dorsal flap. A catheter was inserted and removed after twenty-four hours. The patient made an uninterrupted recovery and was discharged on March 5. As the glands in the right inguinal region were small and movable, and in view of the general state of the patient, no attempt was made to remove them at this time.

FIG. 405.—The amputated penis, showing the growth from the ventral aspect.

NAKED-EYE APPEARANCES.—The specimen (*Fig.* 405) shows the amputated penis from the ventral aspect, with the urethral floor split open. The growth can be seen arising from the roof of the fossa navicularis and running round the lateral walls, but not to a sufficient extent to cause, at this stage, a urethral stricture. The resultant ulcer has a surface with a red granular appearance, and an edge that is raised and everted. Deep to it the growth invades the substance of the glans to a slight extent. Between the growth and the external urinary meatus there is quite definitely an area of normal urethra.

MICROSCOPIC APPEARANCES.—The following report of the microscopic examination was provided for me by Dr. D. C. L. Derry, the Pathologist to the Surgical Unit, to whom I take this opportunity of expressing my thanks: "On section the tumour shows cords of typical epithelial cells invading the lamina propria of the glans. These cells have large round or oval vesicular

FIG. 406.—Low-power microphotograph of the malignant tissue.

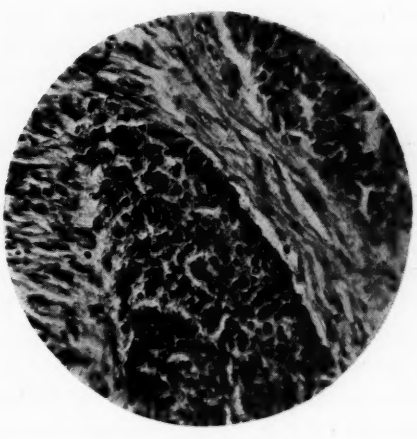

FIG. 407.—High-power microphotograph of a portion of *Fig.* 406.

nuclei, with a large eosinophilic nucleolus, and pale-staining granular cytoplasm. A few mitotic figures are present, and the usual round-celled

infiltration surrounds the growth. There are no 'prickle-cells' or 'epithelial pearls' among the cords of tumour cells. Diagnosis: squamous-celled carcinoma of the transitional-cell type." (*Figs.* 406, 407.)

DISCUSSION.

The age incidence of this condition has wide variation. The youngest patient was a youth of 18 years, described by Paton, whilst at the other extreme is a nonagenarian. The disease, however, appears to be commonest between the sixth and seventh decades. The etiological factors, as ascertained from the literature, are a previous history of gonorrhœa, trauma from the passage of sounds or other causes, and chronic urinary infection. Gonorrhœa easily heads the list, usually associated with stricture. In one of Robb's cases it is interesting to note that sounds were passed on 477 occasions, a particularly inquisitorial method of producing chronic irritation. Kretschner associated a case with the irritation produced by the injection of Hartzell's solution.

With regard to the site, there is a great affinity for the perineal urethra. Diehl, in reviewing 61 cases, found that 33 were in the membranous urethra, 26 in the bulbous urethra, and only 2 in the fossa navicularis. Other authors report much the same proportions. This common position is to be expected, as the predisposing factors of gonorrhœa and stricture make their mark mostly in this region.

The outstanding point of interest in the microscopy of the growth is the preponderance of the squamous-celled variety. Robb, in an analysis of 76 cases, found 72·5 per cent were squamous-celled, 21·2 per cent adenocarcinomata, 3·5 per cent papillary, 1·5 per cent columnar-celled, and 1·3 per cent transitional-celled. Bieberbach and Peters state that 60 per cent are squamous-celled, and other writers are of the same opinion. Normally the epithelium lining the perineal part of the urethra (the common site for the disease) is columnar, but Sobotta states that it is usually of a stratified columnar type and in some individuals islets of squamous epithelium can be seen. The change is probably best explained by metaplasia consequent on the malignant transformation, although the possibility of embryonal cell-nests has been suggested. In this case, although the growth occurred in the region of the fossa navicularis, where stratified squamous epithelium is usual, it assumed the form of a transitional-celled growth, a type which might reasonably be expected in the prostatic urethra.

When the growth affects the penile portion of the urethra, the symptoms are such as might be anticipated, and are well illustrated by this case. The occurrence of a bloody discharge or hæmaturia at the commencement of micturition, together with the feeling by the patient of a nodule on the under surface of the penis, should at any rate suggest to the surgeon's mind the possibility of the diagnosis of carcinoma. At a later stage the onset of urethral obstruction will cause lessening or diversion of the urinary stream, followed by complete stoppage.

In the perineal urethra the diagnosis is in most cases not made till late, and the explanation does not require exhaustive search. The association of

gonorrhœa and urethral stricture naturally focuses the attention on this condition alone, while, owing to the depth of the urethra and its inaccessibility, attention is not drawn to any nodule of tumour until it is of considerable size. When the growth has eroded the urethral wall, local extravasation and peri-urethral abscess follow very rapidly, and this, being associated with an inflammatory stricture or the passage of sounds, leads to the not unnatural adoption of the simpler diagnosis. The treatment of the abscess is soon followed by fungation of the growth and the true diagnosis then becomes apparent. The use of the urethroscope in suspected cases may be of assistance.

The statement that glandular metastases are clinically late may be due to the fact that the lymphatics of the deep urethra drain into the iliac glands, where palpation is impossible. The early death of the patients, as indicated in the literature, suggests that this deep lymphatic invasion often occurs unobserved. In disease of the anterior penile urethra the inguinal lymphatics are affected, and, in the case here recorded, were palpable on one side. This enlargement, however, may be due either wholly or partially to sepsis consequent on the malignant ulceration.

In this case the treatment adopted, for the reasons stated, was a conservative amputation. In a younger patient with a growth of the penile portion, treatment by radium should be well worth trying, for a successful result would leave the patient without deformity—a very important factor from a functional and psychological standpoint.

If radium therapy fails (and provided the patient is kept carefully under observation), amputation may then be resorted to before the condition has reached the stage of hopeless inoperability. As far as I am aware, there are no published results of radium treatment of this particular lesion. Our present knowledge of the use of radium and its application to various types of malignant epithelial growths would lead one to expect a fair measure of success, as the majority of the growths recorded are of the squamous variety.

When, however, the disease is manifested in the perineal urethra, its association with peri-urethral abscess and invasion of the surrounding tissues will in most cases prevent radical treatment. For early cases the method of penis extirpation described by Huggins and Curtis should be tried, as with radium the degree of retrogression may be difficult to observe and any recurrence easily overlooked. The very fact that an associated stricture is so prevalent makes the introduction of radium per urethram no easy matter, so that the insertion by the perineal route would be the method of choice. For advanced growths, and those opened under the misdiagnosis of simple peri-urethral abscess, radium seems to be the only method applicable.

A consideration of the results as published in the literature indicates a gloomy prognosis. The majority of patients succumb to the disease in from six months to two years. Kretschner, however, reports one case alive and well after two years. In the case reported here the time interval since operation is too short for a discussion of results. Recurrence takes place locally, with or without spread in the inguinal and iliac glands. The poor outlook must be ascribed to the usual position of the growth in the perineal urethra, which makes complete extirpation difficult, and in most cases to the

mistaken diagnosis of peri-urethral abscess. When the position of the growth is the fossa navicularis the outlook should be more hopeful.

Carcinoma of the urethra is probably not such a rare condition as the literature suggests, for it is more than probable that many cases are not recorded. Association of the condition with stricture and peri-urethral abscess should be borne in mind, as it is obviously essential to make an early diagnosis. The high proportion of squamous-celled growths in the urethra and the recent improvement in the treatment by modern radium therapy of this type of neoplastic cell in the genito-urinary system make such a method of treatment well worth a trial in an otherwise almost hopeless condition.

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A CASE OF DIFFUSE POLYPOSIS OF THE STOMACH

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Polyposis of the stomach, especially in its *diffuse* form, is a condition of such interest and rarity as to justify the addition of yet another case to the list of those on record.

The disease is characterized by the presence of numerous polypi distributed over the mucosa of the stomach; the polypi are of various sizes and may be sessile or pedunculated. Balfour regards it as the most uncommon of all benign tumours of the stomach and states that it was found once only in 8000 operations for gastric lesions at the Mayo Clinic. Brunn and Pearl were able to collect 84 cases from the literature of the period 1820–1925, including 5 cases of their own; their review of the subject is by far the most comprehensive of any to be found among the more recent publications. Menetrier, in 1888, was the first to give a detailed description of the disease. He recognized two forms: in the one the polypi are aggregated into a localized plaque ('polyadenomes en nappe'); in the other they are diffusely scattered over a considerable area of the mucosa ('polyadenomes polypeaux').

The following case is an unusually good example of the diffuse form of the disease in a simple 'hour-glass' stomach.

History.—A married woman of 57, engaged in housework, who had spent all her life in England, was admitted to hospital with the following history. For fourteen years she had suffered from *indigestion* characterized by attacks of severe epigastric discomfort, or actual pain of a 'burning' nature, always made worse by the ingestion of food. In the intervals between the attacks she had been quite free from discomfort, often for many weeks at a time. For six months before admission the attacks had become more frequent and severe; in addition *vomiting* and *diarrhœa* had supervened with increasing frequency. For many weeks these latter symptoms had been of daily occurrence; every meal had been vomited; the vomitus was light in colour, small in quantity, and odourless; it contained no blood, but a great deal of 'froth' and sometimes 'slime'. The motions had been frequent, loose, and very dark in colour. She had *lost weight steadily* for the last two or three months. *Appetite* had always been good; at times she had felt hungry, but had feared to eat because of the vomiting which would invariably follow. She had always been very moderate in the use of alcohol. She had never miscarried and had given birth to a healthy child.

On Examination.—The patient was of the thin muscular type with a sallow complexion. The abdomen, chest, and nervous system showed no abnormality. The blood-pressure was 110 systolic and 80 diastolic; the radial and temporal arteries were soft and elastic. Digital examination of the rectum revealed nothing abnormal. Blood examination showed: red

cells, 5,500,000; white cells, 13,000 (polymorphs, 64 per cent); hæmoglobin, 100 per cent; colour index, 0·9; blood group, III. No abnormal cells were seen. The Wassermann reaction (blood) was negative. X-ray examination after a barium meal showed a well-marked 'hour-glass' deformity of the stomach; both loculi were large with regular contours, and the channel between them was very narrow. A barium enema revealed no abnormality in the cæcum, colon, or rectum.

A diagnosis of simple 'hour-glass' stomach was made and operation advised. Unfortunately a test-meal was not given at this stage of the investigation.

Operation.—Operation under general anæsthesia disclosed a well-developed 'hour-glass' stomach; the constriction lay well above the middle of the organ, and, though narrow, it was not particularly indurated; both loculi were large, especially the distal one, which gave to the examining fingers the impression of considerable hypertrophy. The stomach was low in position and free from adhesion to neighbouring structures; its peritoneal coat presented a normal appearance; there was no localized induration anywhere apart from the slight thickening caused by the constriction. There was no enlargement of glands in the omenta, at the cœliac axis, or in the hilum of the liver. Examination of the rest of the abdominal contents showed no abnormality other than a general visceroptosis. Owing to the low position of the stomach and its freedom from adhesions, a partial gastrectomy by the Balfour method (jejunum in front of colon with efferent loop from greater curve) was carried out without difficulty, the section through the proximal loculus being made $1\frac{1}{2}$ in. above the constriction. When the stomach was divided it was noticed that its mucosa was thicker than usual and studded all over with minute polypi, sessile in form. The mucosæ of the duodenum and jejunum were normal. Approximately two-thirds of the stomach was resected.

The patient made a satisfactory recovery from the operation and left the hospital four weeks later, stating that she felt better than she had for months previously. Her colour and general appearance had improved; she was able to take her meals without discomfort; the vomiting had ceased; and the bowels were acting normally.

A test-meal was given during the fourth week of convalescence and showed a total achlorhydria. A second blood examination carried out at the same time showed: red cells, 4,500,000; white cells, 4,700; hæmoglobin, 78 per cent; colour index, 0·85.

Before she left hospital the rectum and colon were examined with the sigmoidoscope and nothing abnormal was detected.

When seen eight months after the operation she looked well; she had gained in weight; she was taking an ordinary diet and enjoying it; and, with the exception of some slight frequency of micturition, she had no symptoms whatever.

Description of Specimen.—The distal loculus is large; it measures 5 in. along the lesser curve. The aperture of the constriction is narrow and only just admits the forefinger; its diameter is $\frac{3}{4}$ in. The duodenal mucosa and musculature are normal right up to the pylorus, where an abrupt change

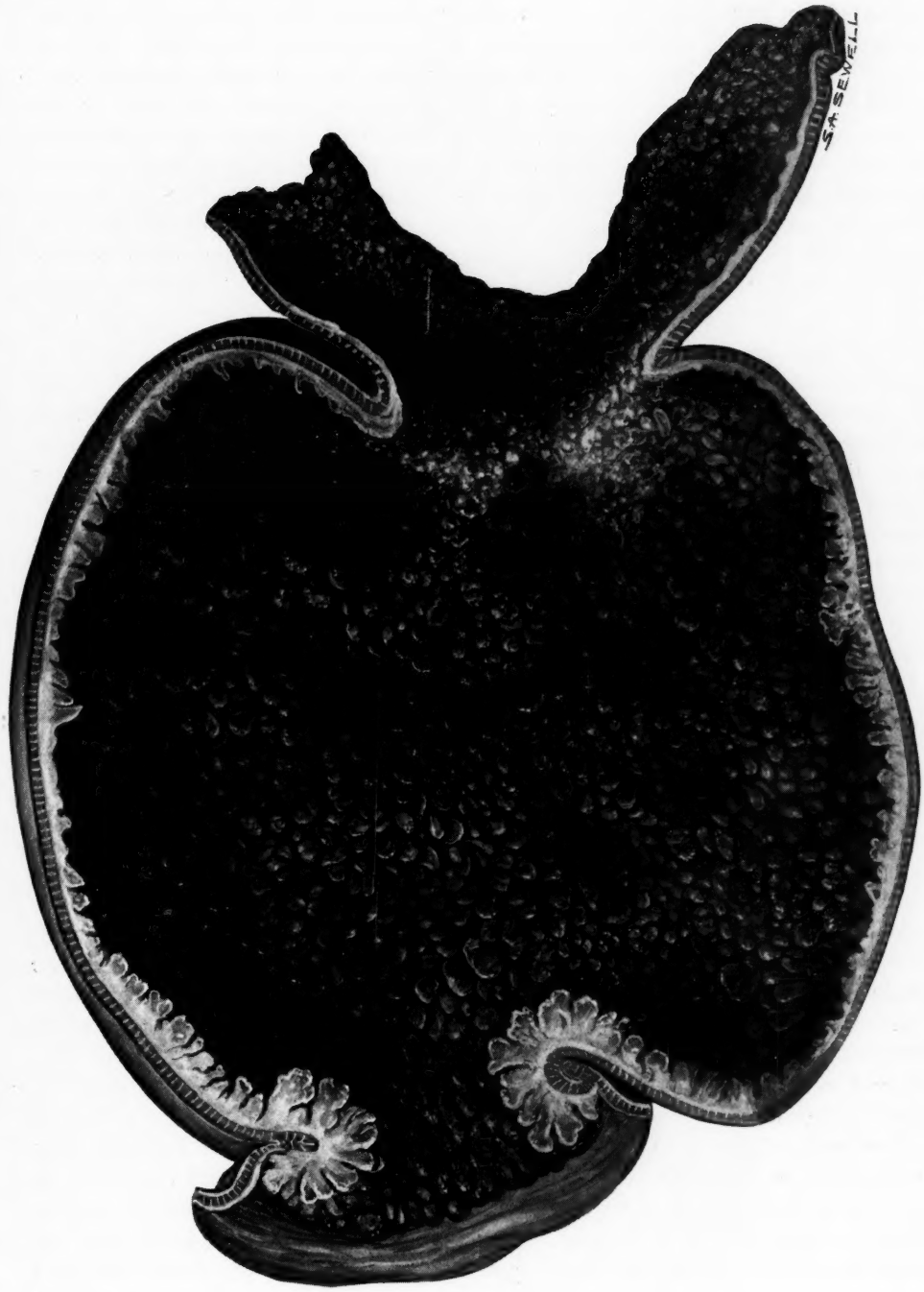

FIG. 408.—Showing the interior of the specimen exposed by an incision along the greater curve. On the left is seen the normal mucosa of the duodenum, contrasting sharply with that of the pylorus, which is polypous and prolapsed. On the right is seen the 'hour-glass' constriction. ($\times \frac{3}{4}$.)

is evident, for through the canal numerous dark-coloured polypoid masses project, resembling a number of prolapsed and œdematous piles. The polypi have definitely obstructed the lumen of the pyloric canal, which just allows the passage of a pair of Spencer Wells artery forceps. The peritoneal covering on both anterior and posterior surfaces of the specimen is normal. A few small and apparently normal glands are present in the gastro-hepatic and gastrocolic omenta. The interior of the specimen, when exposed by an incision along the greater curve, exhibits a diffuse pathological change which differs somewhat in the two loculi (*Fig.* 408). The distal loculus is covered with closely-packed polypoid projections of the mucous membrane, mostly about $\frac{1}{3}$ in. in width and height; most of the projections are rounded, but in some areas they are flattened or elongated by pressure; some are pedunculated and others are sessile; a few attain a diameter of $\frac{1}{2}$ in.; there are groups of polypi of a deep red colour from congestion or extravasation of blood, giving the general appearance of a patchy inflammation. With a reading lens many smaller polypi of various sizes are seen lying between the larger ones; as many as forty polypi to the square inch may be counted in several areas. In the proximal loculus, on the line of constriction, and over a small area adjacent to the constriction on its pyloric side, the mucous membrane is slightly thickened, having the 'mammillated' appearance of chronic gastritis; here the projections are small and mostly sessile in form. The mucosa of both loculi is covered with a thin layer of mucus. There is no evidence of ulceration anywhere. The muscular coat of the stomach is slightly hypertrophied, but nowhere is any localized induration felt, except at the constriction, which is just palpable as an even and slightly thickened ring.

Microscopic Examination.—

The Distal Loculus.—Two sections were examined; one through the pyloric sphincter and adjoining portion of the duodenum (*Fig.* 409); another from the region of the greater curve at the middle of the loculus. The mucosa is thickened and polypous; the polyps, in transverse and longitudinal section, are seen to be composed chiefly of mucosal crypts with abundant stroma; occasional crypts are distended to form small cysts. The epithelial cells are typical. The deeper part of the mucosa is composed of typical fundal or pyloric glands, which rarely pass up a short distance into the polyps; in the fundal glands parietal cells are numerous. There are hæmorrhages in the summits of many of the polyps; their stroma is œdematous and its capillaries are distended. The stroma is densely infiltrated with plasma cells, eosinophil leucocytes, and lymphoid cells, and in places with neutrophil leucocytes. There are also numerous large round cells whose cytoplasm is occupied by hyaline eosinophilous bodies (Russell bodies). In one polyp these cells are very numerous, filling the greater part of the stroma. The infiltration is somewhat less in the deeper parts of the mucosa between and deep to the glands; here there are a few lymphoid nodules. There is a moderate degree of fibrosis, with few spindle cells, throughout the mucosa. The muscularis mucosæ is normal except for slight inflammatory infiltration similar to that in the mucosa. In the submucosa and muscularis externa there is a similar but very slight and focal infiltration. A few mast cells are present in the muscularis externa.

FIG. 409.—Section through the pyloric sphincter, showing polypi in transverse and longitudinal section. In the lower part of the drawing the normal mucosa of the duodenum is seen. (× 3.)

FIG. 410.—A polyp in transverse section (× 60.)

The microscopic appearances suggest that chronic inflammation has produced polypous thickening of the mucosa. The mucosa of the duodenum is not thickened; it is densely infiltrated with plasma cells and eosinophil leucocytes. *Fig.* 410 shows a polyp in transverse section.

The Proximal Loculus.—One section was examined from the region of the greater curve. The mucosa is not polypous and is thinner than that of the distal loculus. Its stroma is œdematous, congested, and infiltrated with plasma cells, lymphoid cells, and eosinophil leucocytes; there are a few cells containing Russell bodies and very few neutrophil leucocytes. These features are much less conspicuous than in the distal loculus. The other coats are normal.

The Constriction.—A section was made from the lesser curve in a longitudinal direction, cutting the constriction transversely. At the small area of constriction there is great fibrosis of the lesser omentum and of the muscularis externa, though everywhere in this scar in the muscularis externa there are at least small bundles of muscle fibres. The muscularis externa is fused with the muscularis mucosæ, the fibres of the latter being separated by increased fibrous tissue. Spindle cells in the scar tissue are small and not numerous and there are very few round cells. The mucosa is thin but complete over the scar. The thickened polypous mucosa of the distal loculus on the one side of the scar contrasts conspicuously with the thinner mucosa of the proximal loculus on the other side.

Lymphatic Gland.—Only one lymphatic gland (0·5 × 0·3 cm.) was attached to the specimen. Its sinuses are broad, with many endothelial cells. The peri-adenoid connective tissue is slightly infiltrated with plasma cells.

There was no evidence of malignant change in any of the sections examined.

Etiology.—The etiology of the disease is obscure. There is some evidence that a *congenital* factor may be present, for it has been found in twins, in brothers and sisters, and in mother and son; in this connection it is of interest to note that there is a distinct familial tendency in the analogous condition of polyposis of the small intestine and colon. Syphilis, tuberculosis, alcohol, and arteriosclerosis have all been blamed, but there is no real evidence that they are important etiological factors.

According to Brunn and Pearl the disease occurs most frequently in the sixth and seventh decades of life; the youngest case reported was in a girl of 20; males are more often affected than females. The condition is sometimes associated with generalized polyposis of the intestinal tract; this was so in 7 per cent of Brunn and Pearl's cases.

The true *nature of the morbid process* is still a matter of uncertainty. Evidence of this is to be seen in the variety of names given to the disease: gastritis polyposa, adenomatosis gastrica, papillomatosis gastrica, polyadenoma gastrica, diffuse gastric polyposis, and adenopapillomatosis gastrica. The tumours are generally referred to as 'adenomata'; they are covered by a single layer of columnar or cuboidal cells arranged in an orderly manner and limited by the muscularis mucosæ. In many of the cases recorded there was evidence of *chronic inflammation* of the gastric mucosa. Considerable stress is laid by

some writers on the presence of polynuclears and lymphocytes in the stroma, while others specifically record their absence. Menetrier insists that the polyposis is secondary to chronic gastritis, while others regard the inflammatory changes as secondary—a view which is supported by the fact that polyp formation is rare in cases of chronic gastritis. Mills considers that the tumours should be designated 'papillomata' rather than 'adenomata', as no capsule is present; he further suggests that they may be of the nature of infected warts similar to those found on the skin. Brunn and Pearl found evidence of chronic inflammation in only 32 per cent of their cases; they consider that the term 'adenopapillomatosis' most accurately describes the pathological picture, and that the disease may originate in two ways: (1) As a congenital hypertrophy of the epithelium; (2) As a hyperplasia acquired through chronic inflammation. One writer claims to have discovered all stages from hypertrophic gastritis to adenomatous formation and even to carcinomatous change (Konjetzny).

That *chronic irritation* can produce polypoid growths in the stomach seems proved by the experiments of Fibigen and Wassink, who produced diffuse polyposis in the stomachs of rats by feeding them on cockroaches infected with the larvæ of certain nematodes; they were able to follow the lesions through from the initial stages of simple epithelial hyperplasia to malignant degeneration. Papillary adenomata have also been produced experimentally by the injection of coal-tar into the submucosa of rabbit's stomachs (Ishibashi and Ohtani).

It is of interest to note that the specimen described by the present writer is classified in the Museum of the Royal College of Surgeons of England under the heading of 'chronic hypertrophic gastritis'. The sequence of events in this case was probably as follows: the patient had a gastric ulcer which healed and produced a bilocular stomach; in association with this an unusual degree of chronic gastritis developed in the distal loculus; this led to thickening of the mucosa and the formation of inflammatory polyps; these in their turn caused progressive obstruction of the pylorus with consequent stasis and further gastritis; and in this way a vicious circle was established. It is suggested that these polypi should be regarded as blastomatoid in origin rather than as true tumour formations.

Association with Carcinoma.—It is generally agreed that polyposis of the stomach is not commonly associated with carcinoma. The two diseases were present together in only 12 per cent of Brunn and Pearl's cases. Of 263 cases of carcinoma of the stomach examined by Stewart, only 13 were associated with polypi (4·9 per cent). This is in marked contrast with the case of the colon and rectum, where the two conditions co-exist much more frequently; thus of 33 cases of carcinoma of the colon and rectum examined by Dukes, as many as 25 showed associated polyposis (75 per cent). Stewart concludes that: "Simple adenomatous polypi of the stomach, whether single or multiple, must therefore be accepted as a definitely precancerous lesion, but the available evidence goes to show that the association is much less intimate than in the case of the large intestine."

The Diagnosis of Gastric Polyposis.—In the majority of the cases reported the specimens have been obtained from the post-mortem room, the

disease having been unrecognized during life. In recent years operation has led to the discovery of an increasing number; in only a few instances has the diagnosis been made before operation. There are no characteristic symptoms whatever. In a few cases the diagnosis has been made on X-ray examination (e.g., Carman in 1917 and Balfour in 1919); the characteristic picture is one of irregular defects in the contour of the stomach due to indentation by the polyps; this appearance in a case of chronic dyspepsia with achlorhydria and the vomiting of blood-stained mucus is suggestive of polyposis. It is to radiography, therefore, that we must look in the future for precision in the diagnosis of this uncommon disease. One case is reported in which the condition was recognized by the gastroscope (Schindler, 1922); in another (Wegele, 1909) the finding of a polyp on the tube used for gastric lavage led to the diagnosis. In those cases in which test-meals have been carried out *achlorhydria* was a constant finding.

SUMMARY.

1. A case of diffuse polyposis in a simple 'hour-glass' stomach is described.

2. The main symptoms were those of a chronic dyspepsia on which had supervened the more acute symptoms of persistent vomiting and diarrhœa.

3. The condition was not recognized until the specimen had been removed by operation.

4. The microscopic appearances suggest that chronic inflammation had produced polypous thickening of the gastric mucosa.

5. There was no evidence of malignancy.

6. The disease is uncommon; only 84 cases have hitherto been recorded.

The writer is indebted to Dr. W. W. Woods, of the Pathological Institute of the London Hospital, and to Mr. T. W. P. Lawrence, of the Royal College of Surgeons, for help in the interpretation of the microscopic findings in this case.

The specimen is preserved in the Museum of the Royal College of Surgeons of England (No. 6202.1).

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THE TREATMENT OF ACUTE EMPYEMA IN INFANCY AND CHILDHOOD.

WITH A REPORT OF 75 CASES TREATED BY CLOSED DRAINAGE.

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Empyema thoracis is a common disease of childhood. Three per cent of admissions to the surgical wards of our Children's Hospital are for this condition. With us it is more common than acute appendicitis. The high mortality with which it is attended, especially in the first two years of life, may be taken as sufficient proof that treatment has been unsatisfactory. The following table gives the death-rate from acute empyema in children under two years of age in some representative American hospitals These statistics warrant continued search for new or improved methods of treatment in this disease, which has taken such a marked toll of life in the period of infancy.

Hospital	Period	Mortality
		Per cent
Baby's Hospital, New York ..	1903–13	37·8
Bellevue Hospital	1920–4	34·8
Children's Hospital, Boston ..	Prior to 1924	35·0
Johns Hopkins Hospital ..	1889–1927	29·6
Johns Hopkins Hospital ..	1927–9	22·2

More than forty years ago Beulau inserted a catheter through a trocar into the thorax, and applied negative pressure drainage. While the occasional surgeon has come forward from time to time to advocate the closed method of treatment in empyema, it has not had very wide application. A considerable number of operators have tried it in a few cases, only to abandon it when technical difficulties in its application were met with. One of the main difficulties was leakage around the catheter, which occurred in a few days or at best a week. Trouble was also experienced on account of the opening in the catheter becoming plugged with lumps of fibrin. The apparatus often leaked and otherwise went out of order. In a considerable number of cases rib resection was performed as a way out of the difficulty.

The author has used the method of applying closed drainage here described in seventy-five consecutive cases and has found the results obtained to be so much better than those experienced with the open method that the latter has been entirely abandoned. Nothing original is claimed either for method or for apparatus. We have worked out a mode of application that

has proved satisfactory with us, and I feel entirely confident that it will prove to be just as satisfactory in the hands of others, if sufficient attention is paid to the details of its use. It has already been described briefly in a paper read by me at the meeting of the British Medical Association in Winnipeg in 1930 which was later published in the *British Medical Journal.* It is described here in more detail, with correction of some minor errors in the illustration of the apparatus which were unfortunately overlooked at that time. Thirty-three additional cases are added, making seventy-six cases in all treated by the method.

Regardless of what form of treatment is used in empyema there are certain principles which, I think all surgeons will agree, must be kept in mind. First, the operation to provide drainage must be delayed long enough for the lung to become firmly adherent, in order that lung collapse may be prevented when the thorax is opened. Secondly, the more acute stage of

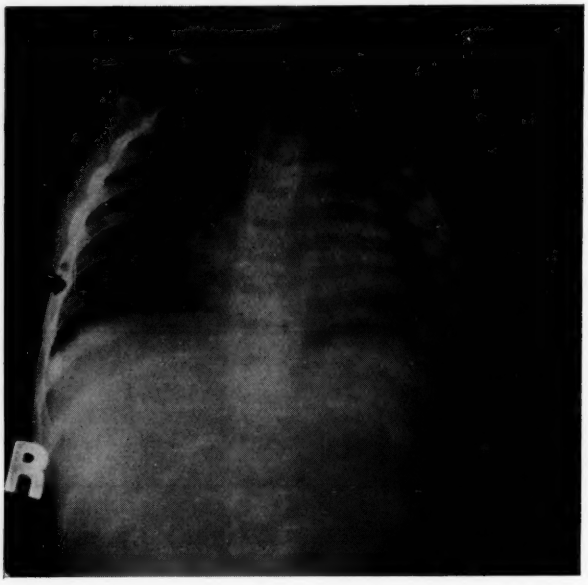

FIG. 411.—Showing a case of empyema with lung collapse as a result of air being allowed to enter the chest during paracentesis.

the illness should be over, with improvement in the general condition and the pneumonic process resolved before the child is subjected to operation.

How, then, is one to know when adhesions between lung and chest wall are firm enough to prevent lung collapse, with enlargement of the cavity and spread of infection, when air is allowed to enter the thorax? We know that in cases of pneumonia due to the pneumococcus involvement of the pleura occurs late. Usually the pneumonia will have resolved before the empyema is discovered. Adhesions between the lung and chest wall form quickly and firmly. On the other hand, if the invading organism is the streptococcus, involvement of the pleura may occur early, perhaps on the third or fourth day following the onset of the acute illness, when the pneumonic process is

at its height and when the lung adhesions are absent or very weak. Open thoracotomy at this stage with massive collapse of the lung must be looked upon as a catastrophe. We have the following rule at the Children's Hospital as a practical working basis: When the organism present is the pneumococcus, *thick* pus must be present in the pleural cavity for at least a week before the empyema is drained; when we are dealing with the streptococcus, *thick* pus must be present for at least ten days before drainage is undertaken. While we are waiting the child is kept comfortable by removal of the pus by aspiration as often as we think necessary, depending upon the rapidity with which it re-accumulates.

A word about aspiration of the chest may not be out of place here. A considerable number of our cases admitted to hospital have had the chest aspirated either for diagnosis or treatment. In a number of these we have found air present in the empyema cavity, sometimes in small amounts, occasionally in large quantities with marked collapse of the lung (*Fig.* 411). We are firmly of the opinion that the introduction of air into the cavity in

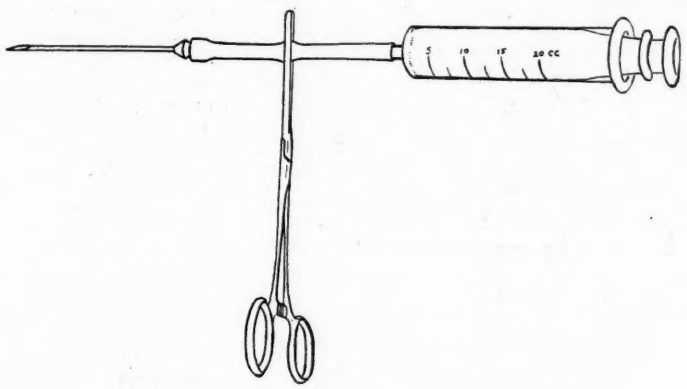

FIG. 412.—Showing method used in aspirating chest.

this manner in the early stages of the disease causes spread of infection and forms an additional menace to the life of the patient. It is our experience that these patients run a stormier course than those in which the accident has not been allowed to occur. To aspirate the chest either for purposes of diagnosis or treatment we use the simple apparatus illustrated in *Fig.* 412. It consists of a good-sized needle with a piece of rubber tubing about 5 in. long pushed on over the end. An artery forceps clamped on this tubing prevents the entrance of air when the needle is being introduced into the chest and when the syringe is detached for emptying. By using a large syringe any amount of pus may be withdrawn quite conveniently. If the syringe is attached directly to the needle, leakage of air frequently occurs at the point of connection; the same applies when the tubing is attached to an adapter which fits into the needle. The entrance of very large amounts of air is, however, usually due to the end of the needle being left unprotected when the syringe is removed for emptying.

Apparatus.—The apparatus which we use for the application of suction and irrigation is very simple. It consists of three ordinary Winchester

bottles, with tight-fitting rubber stoppers pierced with two holes, some glass tubing, a container for Dakin's solution, and some rubber tubing of suitable size, all of which may be obtained at any chemist at a small cost (*Fig.* 413). The A bottle is used simply as a trap to prevent the washings from the empyema cavity from becoming mixed with the water from the siphon. It is essential that the corks fit tightly in the bottles and that the glass tubing fit tightly in the corks, otherwise difficulty will be experienced in maintaining the suction on account of leakage of air. If leakage about the corks does occur, it can usually be stopped in the following manner: Place a cuff of adhesive plaster about the neck of the bottle so that the top of the adhesive

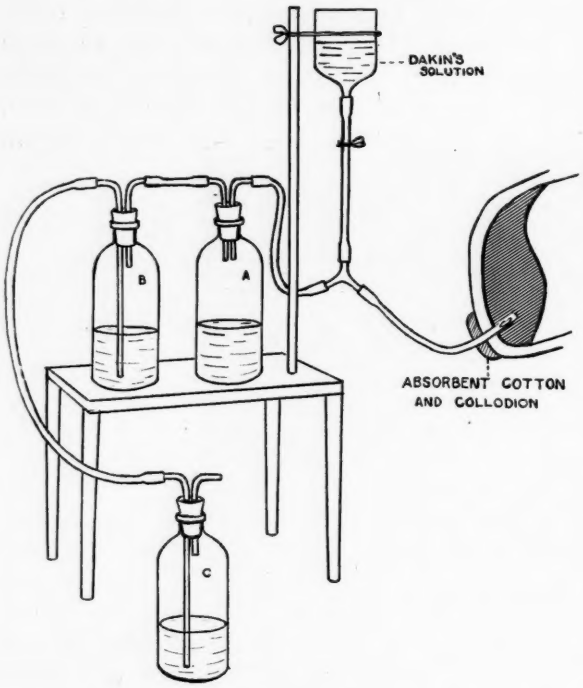

FIG. 413.—Closed drainage in empyema. To irrigate the cavity the rubber tube connecting the Y glass connection with bottle A is clamped, after which the clamp is removed from the tube connecting the Y with the container for Dakin's solution; when the abscess cavity is filled the solution is clamped off and the clamp betweed the Y connection and bottle A removed, allowing the solution to drain off by suction into bottle A. To remove the solution accumulated in bottle A, clamp both rubber tubes leading from the glass connections in the cork; the cork may then be withdrawn and the bottle emptied without disturbing the siphon. Bottles B and C are interchangeable. When bottle B is nearly empty place a clamp on the rubber tubing between bottles A and B and another clamp in the tube between bottles B and C; the bottles are then changed, placing the empty one on the floor and the full one on the table.

extends about $\frac{3}{4}$ in. above the top of the cork. Now melt some grocer's paraffin to which a small quantity of vaseline has been added, and when it has become liquid pour it into the cup formed by the adhesive plaster. This will effectively seal all openings through which air might enter. This procedure is not recommended as a routine, for it has to be repeated if the cork is removed from the bottle or if the glass tubing is disturbed to any great extent.

Technique of Operation.—The operation is performed under local anæsthesia and can be carried out quite readily in bed if the patient is too ill to be moved. In the case of infants and children a catheter size No. 16 or No. 18 (French) is used. This catheter fits so snugly into the cannula that when it is lubricated with glycerin no air can enter around it. An artery forceps clamped on the catheter near the end prevents the entrance of air through its lumen. The trocar with cannula is introduced between the ribs at

the most convenient point. The trocar is then withdrawn and immediately the index finger is placed over the end of the cannula to exclude air. The operator now takes the catheter in his right hand, removes his finger from the end of the cannula, and at once inserts it. In this way the catheter is introduced into the pleural cavity without the admission of air, excepting the small amount that might enter upon removal of the trocar and insertion of the catheter.

Even though one feels that the lung is attached to the chest wall by adhesions sufficiently firm to prevent its collapse if air was allowed to enter, every possible precaution is taken to avoid this undesired complication, for we look upon lung collapse in empyema as nothing short of a calamity. The catheter, which has a lateral eye $\frac{1}{2}$ in. above the terminal one, is allowed to project into the cavity $1\frac{1}{4}$ in. In order that one may know its position in the chest a mark is necessary. If, before beginning the operation, the operator places the catheter beside the cannula allowing it to project the required $1\frac{1}{4}$ in. beyond its end, and with the scissors removes a small chip from its wall opposite the distal end, he will have a landmark that is quite satisfactory. With the catheter now in place the cannula is removed.

Before removing the clamp on the end of the catheter to take off the cannula a clamp is placed on the proximal side of the cannula for obvious reasons. Then comes the very important step of sealing the opening about the catheter. This is accomplished by applying successive layers of absorbent cotton to which collodion is applied with a brush until a collar, 5 in. in diameter and $\frac{1}{2}$ in. thick, is built up about the tube. In order that this dressing may adhere firmly to the skin and adjacent catheter these parts must be thoroughly clean and dry. This is brought about by washing them carefully with ether. To begin the application of the dressing a layer of collodion is applied to the skin with the brush. A thin layer of cotton is then laid on this base and smoothed out with the brush which has been dipped in the collodion. This ensures good cohesion between the dressing and the skin. By the application of successive layers of cotton in a similar manner the dressing is built up to the required thickness. We have found that the dressing will remain tight longer if the catheter is held immovable in the chest wall. This is accomplished in the following manner: When the dressing is about half applied a small round needle threaded with a double strand of silk is passed through the wall of the catheter (without entering its lumen) flush with the surface of the dressing. This double thread is then cut, leaving the ends about 2 in. in length. Another thread is then passed through the opposite wall of the catheter in a similar manner. These threads are embedded in the dressing as it is completed and effectively prevent movement.

To ensure that the dressing will not be disturbed in moving the child back to bed, it is fanned for twenty minutes before the patient is moved from the operating-table. The child is then returned to the ward with the clamp still on the end of the catheter. To allow the dressing to set more firmly this clamp is left in position for three hours longer, when the catheter is connected up with the apparatus and the clamp removed, and the pus allowed to drain off. If the effusion is large and the surgeon wishes to decompress

the lung slowly, this can be done by removing and applying the clamp at intervals as desired.

Irrigation.—Irrigation of the cavity is begun the following morning—that is, twenty-four hours after the catheter has been inserted. These irrigations are carried out every two hours during the day and three times at night. The top of the fluid in the container for Dakin's solution is never allowed to be more than 18 in. above the opening in the chest, as too much pressure tends to force fluid out around the tube under the dressing, thus loosening it from the skin. To irrigate, a clamp is placed on the rubber tube leading to the A bottle, then the clamp is removed from the tube leading from the Dakin's flask and the solution allowed to run into the chest until it causes pain or stops from the equalization of pressure. This clamp is then replaced and the one on the tube leading to the suction apparatus removed, when the contents of the cavity drain off into the bottle marked A.

If, as sometimes happens, the eye of the catheter becomes plugged with fibrin or thick pus, it can often be freed by stripping the tube in such a way as to force a small amount of solution into the cavity, or, if this fails, by working in opposite fashion, increasing the negative pressure to draw some out. Should this prove unsuccessful, disconnect the catheter from the drainage apparatus, then with a syringe containing Dakin's solution or saline, inject and withdraw small amounts of fluid. This manœuvre is nearly always effective. In only two cases was it necessary to remove the catheter and perform the operation over again, and in both of these cases I had failed to provide the catheter with the lateral eye.

In about 8 per cent of our cases blood appeared in the washings from the cavity. If the return is only slightly tinged, it will probably be sufficient to reduce the amount of negative pressure. This is accomplished by raising bottle C a foot or more from the floor. If, however, blood appears in any considerable quantity, it is advisable to discontinue the irrigation for twenty-four hours. In our experience hæmorrhage has never been a serious complication and has always been readily controlled by the above means.

Occasionally we meet with a case in which the introduction of the solution into the pleural cavity sets up troublesome spasms of coughing. These occur usually at the beginning of treatment and disappear after three or four days. The coughing as a rule begins when the cavity is about filled with solution. By allowing the fluid to run in very slowly and stopping before the danger-point is reached these patients can be carried along until this troublesome symptom disappears.

If a bronchial fistula is present, treatment will have to be adapted to meet that complication. In some of these cases, while the irrigating fluid will enter the bronchus, air from the bronchus will not enter the cavity, so that though irrigation cannot be carried out, yet drainage can be continued with negative pressure. In these cases the irrigations are discontinued until the fistula heals. Sometimes one finds that a certain amount of solution can be allowed to run into the cavity without causing coughing—that is to say, the cough is not brought on until the fluid reaches the level of the opening in the bronchus. By changing the position of these patients one sometimes finds a posture in which a considerable amount of fluid will run into the

cavity without causing coughing. If this can be done, irrigation of the cavity in this modified way is carried out until the fistula heals. If air passes from the bronchus to the cavity, of course negative pressure cannot be maintained. Then a clamp is placed on the catheter, which is removed for a short time every three hours to allow the escape of air or discharge that might be accumulating in the cavity under pressure. When the fistula heals treatment is continued in the regular way.

A question I am often asked, and one to which it is difficult to give a fixed answer, is—When shall the irrigations be discontinued and the catheter removed from the chest? In the average case the temperature drops to normal in two or three days, the cavity gradually becomes smaller, and the amount of pus in the washings rapidly diminishes. The size of the cavity and the amount of pus in the returns are the principal factors which determine the time at which drainage may safely be discontinued. Usually when the cavity holds not more than 15 c.c. of fluid, and when the returns have been free from macroscopic pus for five days, we feel that drainage can be safely discontinued. While this rule will be found satisfactory in most cases, yet something must be left to the judgement of the surgeon in individual cases.

A case comes to mind in which empyema followed spontaneous pneumothorax. The cavity was very large as there was complete collapse of one lung. The patient, a boy, had a bronchial fistula. Following the healing of the fistula, which took place in seven days, irrigations with the continuous application of negative pressure were carried out in the routine way. The lung expanded until the cavity held 8 oz. At this point, however, progress seemed to be arrested in so far as reduction in the size of the cavity was concerned, though the washings were returning free from pus. Notwithstanding the large size of the cavity remaining, the catheter was removed from the chest and a dry dressing applied. This boy made an uneventful recovery, the lung came out to the chest wall later, and he has remained well during the four years which have passed since.

Our routine treatment of the wound after removal of the catheter is to wash the area with alcohol on a sterile sponge and apply a dry dressing.

Results.—Seventy-five consecutive cases of acute empyema in infancy and childhood were treated by the method here described. In 46 cases the organism was the pneumococcus, in 9 the streptococcus, in 6 the staphylococcus, in 1 case a mixed infection of pneumococcus and streptococcus, and in 1 a mixed infection of pneumococcus and staphylococcus. Six cases were reported 'no growth', and in 6 no report could be found. The following group shows the number of cases in each year of life :—

Year	Number	Year	Number
1st	7	7th	6
2nd	14	8th	4
3rd	10	9th	4
4th	6	10th	7
5th	5	11th	1
6th	11		

The youngest child was 4 months and the eldest 11 years. There were two deaths, both in children under 2 years of age, making a mortality for the

series of 2·66 per cent, and a mortality for those under 2 years of age of 9·52 per cent.

One death already reported occurred in a child 14 months old who developed empyema following bronchopneumonia. Vomiting was an outstanding symptom and persisted from the time of admission until death. Necropsy revealed that this child had developed pneumonia of the other lung and that acute pericarditis was also present.

The second occurred in a child 19 months old who was admitted with empyema which arose as a complication of an acute illness which had been present for three weeks and had been diagnosed as influenza. The temperature on admission was 103·4°, and two days later rose to 105°. Bilateral otitis media was present, the left ear discharging and the right drum bulging. A needle was introduced into the chest and 150 c.c. of greenish yellow pus were aspirated which on culture showed streptococcus. The child's condition was very grave and he was vomiting almost continuously. The abdomen was distended. Three days after admission pneumothorax was diagnosed, and on aspirating the chest another 150 c.c. of pus were withdrawn mixed with considerable quantities of air. The air in the chest rapidly re-accumulated, thus embarrassing respiration. As it was found impractical to keep the air removed by repeated aspirations a catheter was introduced in the routine way. Negative pressure could not be maintained, as the air entered the cavity freely through the bronchial fistula. No attempt at irrigation was made. Air and pus escaped through the catheter freely. The patient's condition grew steadily worse—temperature 105°, pulse 160. Vomiting continued until death, which occurred on the tenth day after admission. The parents refused permission for autopsy.

Both children who died presented pictures which were strikingly similar to that seen in fatal cases of infantile cholera. They had the same dehydrated appearance with loose skin and sunken eyes. Vomiting was an outstanding symptom in both, and persisted until death.

There were 7 cases of bronchial fistula. In 4 of these the fistulæ were present before the catheter was introduced into the chest. They all healed in from three to seven days.

There were 3 cases of pocketing. Two of these were discovered while the child was still in hospital, and have already been reported. The third occurred in a child of 9, who returned six months after operation with a pocket situated some three inches above and medial to the original drainage site. Closed drainage in the routine way was instituted, and uneventful recovery followed.

Cellulitis or abscess of the chest wall occurred in 7 cases. In no case did this complication occur as a result of the introduction of the catheter, all having followed aspiration. In 3 cases this condition was present when the patients were admitted to hospital. Recently we have been injecting mercurochrome into the track of the needle with the hope of reducing the incidence of this troublesome complication.

The average number of days of drainage for the seventy-five cases was 21·8. With the exception of the cases of pocketing there were no cases requiring secondary operations, nor were there any instances of chronic empyema.

COMMENT.

The treatment of empyema by the method here described requires more attention to detail on the part of the surgeon than does treatment of the condition by rib resection; but if he is willing to give that extra care, he will be well repaid in the saving of life, the shortening of the period of illness, the leaving of a more normal and better functioning chest wall, and in the comfort he will bring to his patient in the avoidance of painful dressings. This latter advantage alone would, to my mind, be sufficient reason to use the closed method in preference to open drainage. The shortening of

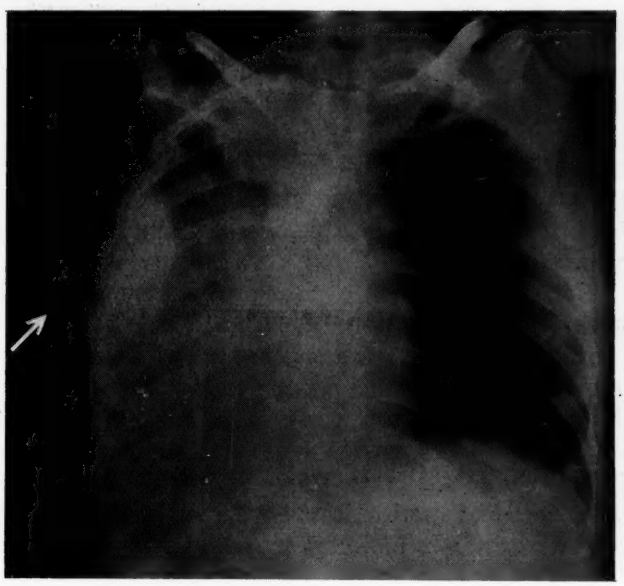

FIG. 414.—Showing a case of encysted empyema.

the time of drainage has considerable economic value. If we take six weeks as the average time of drainage in rib resection, we have by the use of the closed method cut the time in half. We have demonstrated over and over again that for practical purposes the empyema cavity can be rendered sterile by the use of Dakin's solution. It has been said that irrigations with Dakin's solution will increase the incidence of bronchial fistula. We have had no evidence to support that conclusion. In 4 out of the 7 cases which developed, the fistula was present before the catheter was introduced into the chest. For the treatment of encysted empyema (*Fig.* 414) the method is ideal. In not a single case have we found it necessary to resort to rib resection.

CONGENITAL DISLOCATION OF THE HIP IN A CASE OF MULTIPLE CONGENITAL DEFORMITIES.

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A FEMALE child (O. S.), aged 3 years and 4 months, was admitted to Pyrford Orthopædic Hospital in June, 1931, with multiple congenital deformities. She was small for her age and backward, her mental age being that of a child of about 18 months. She showed the widespread failure of normal development of voluntary muscles, with associated contractures of joints, characteristic of the condition known as 'arthrogryphosis multiplex congenita'. The muscle groups most markedly undeveloped were the quadriceps femoris, hamstrings, anterior and posterior tibials, small muscles of the feet, and the muscles of the anterior abdominal wall. There was a marked lordosis of the lumbar spine. Both hips were in a position of fixed flexion of 60°, the left hip being also in fixed adduction of 30°. The left hip was congenitally dislocated. The knees were in full extension with only a few degrees of movement, in contrast to the fixed flexion deformity which is more common in this condition. The right foot was in a position of severe talipes equinovarus; the left showed an equally severe degree of calcaneo-valgus.

On admission the child was very ill with bronchopneumonia. She developed a streptococcal peritonitis, and died three months later. The pelvis and hip-joints were available for investigation after death. Congenital dislocation of the hip-joint in arthrogryphosis multiplex congenita is always extremely difficult, if not impossible, to reduce by manipulation, and an examination of the hip-joints was therefore made to ascertain the particular factors concerned in producing this clinical differentiation from the majority of the more ordinary type of congenital dislocation of the hip. *Fig.* 415 is a diagrammatic drawing of the left hip-joint opened and seen from above and behind.

Description of Specimen of the Left Hip-joint.—As may be seen in the X-ray of the specimen (*Fig.* 416), all the bones of the pelvis, as well as the upper end of the femur, are in a retarded state of ossification on the left side as compared with the right. The neck of the femur is short and abnormally anteverted on the shaft. The specimen does not contain sufficient of the shaft of the femur for the amount of this anteversion to be assessed accurately.

As far as can be ascertained by careful dissection, the muscles about the left hip are normal in their attachment and development and in the arrangement of their nerve-supply. The quadriceps and hamstrings, on the other hand, are poorly developed, and in the lower half of the thigh are mainly replaced by fibrous tissue and fat.

There is marked shortening of the hip flexors and adductors holding the thigh in the flexed and adducted position, and it is impossible to say how far these contractures might have been overcome by forcible stretching during life. The fixation of the hip in adduction is, however, very great, and it seems probable that the resistance of the soft parts alone would have made manipulative reduction extremely difficult.

The gluteal muscles have been divided horizontally above the greater trochanter and the capsule of the hip-joint is opened from above. It was difficult to find the cavity of the hip-joint, as the greatly thickened

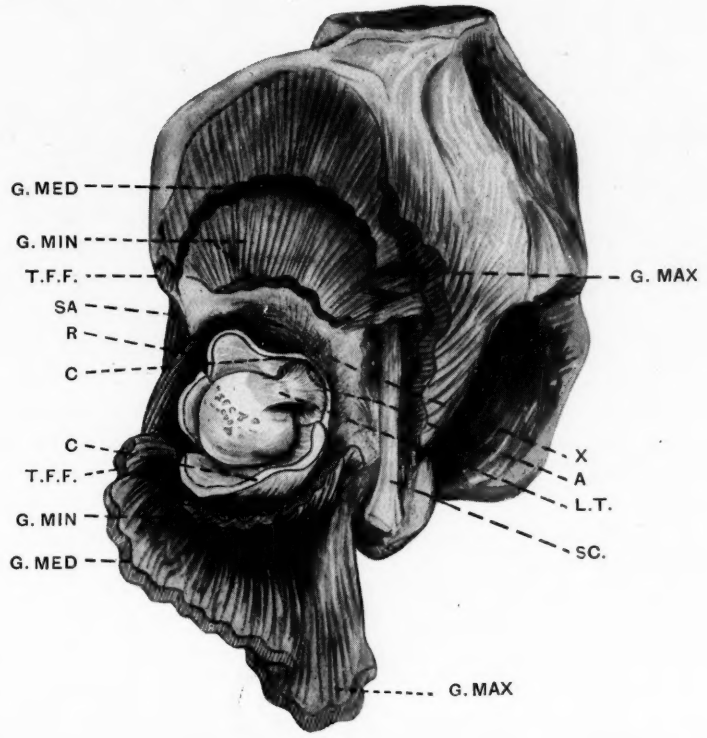
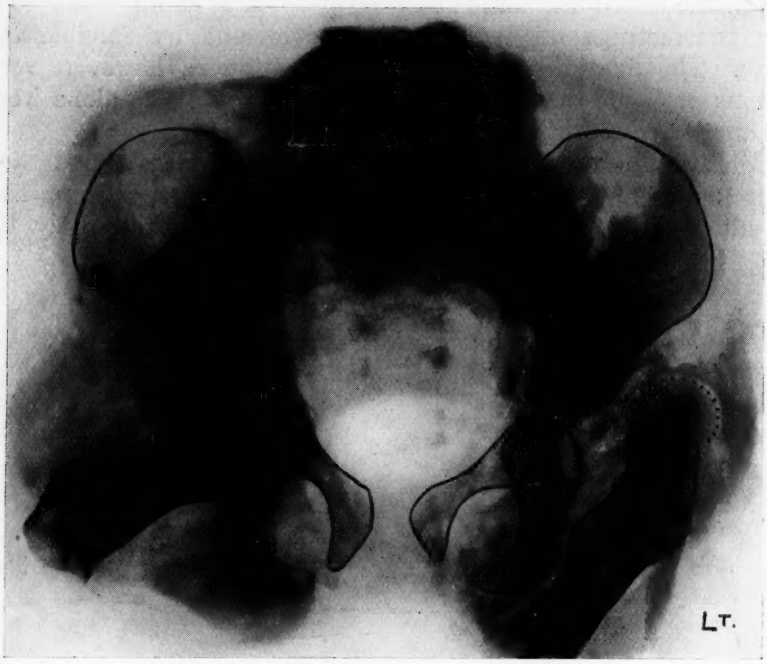


FIG. 415.—Semi-diagrammatic drawing of the hip-joint open. G. MAX, Gluteus maximus; G. MED, Gluteus medius; G. MIN, Gluteus minimus; T.F.F., Tensor fasciæ femoris; SA, Sartorius; R, Rectus femoris (reflected head); SC., Sciatic nerve; C, Capsule of hip-joint; L.T., Ligamentum teres; A, Upper margin acetabulum; X, Area above acetabulum where outer surface of capsule is attached to cartilage of ilium and fascia over reflected head of rectus femoris.

capsule formed a hood over the head of the femur of almost cartilaginous consistency, and the fascia on the deep surface of the muscles was bound so intimately to this that a clear differentiation of the structures in this region was far from easy.

The dome of capsule covering the dislocated head is two and a half times the thickness of the normal capsule on the right side, and consists of dense white fibrous tissue. There is no suggestion of hour-glass contracture of the capsule producing partial separation of the joint space into two compartments, for the capsule passes directly down over the inner aspect of the



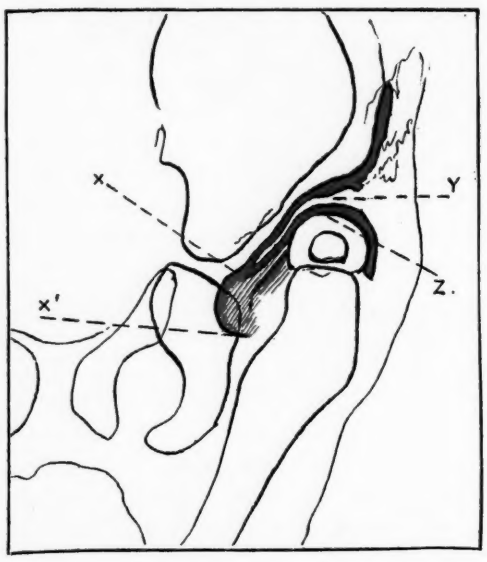


FIG. 416.—Skiagram of the pelvis, and diagram to emphasize some points in the X-ray; the left hip-joint has been opened, but the ligamentum teres is intact and the head bears the same relationship to the acetabulum as during life. The air in the joint outlines the cartilage of the head (Z), and it will be seen that the size of this is greater than that of the acetabulum (X—X¹), which is also defined by the air in the joint cavity. The shadows of the thickened capsule (Y) at the upper part of the joint and of the ligamentum teres are also seen.

femoral head to the margins of a small acetabulum situated at the normal level. Above the acetabulum the outer surface of the capsule is intimately attached to the perichondrium of the ilium and the fascia covering the reflected head of the rectus femoris muscle.

The acetabulum is a sharply defined rounded hollow, only $\frac{1}{2}$ in. in diameter, filled mainly with soft pinkish fat lying in the expanded base of the ligamentum teres. The ligamentum teres spreads out immediately into a flattened band running upwards and outwards over the head of the femur to the fovea capitis. The head is considerably distorted from its normal spherical form, but shows no definite abnormal facets, as the child had not taken weight on the legs. The cartilage on the upper and outer surface of the head shows several small brownish pittings.

There appears to be no real articular cartilage at all on the acetabular side of the joint, but at the upper border of the acetabulum the capsule blends with the underlying cartilage of the ilium, so that in this region cartilage is forming the deep layers of the wall of the joint. This small hollow is the only socket of any kind to receive the head should a reduction be attempted. In the accompanying X-ray of the specimen (*Fig.* 416) the air which has been allowed to enter the joint spaces outlines the hollow of this small acetabulum and also the cartilage of the femoral head, and it can be seen that whereas the diameter of the acetabulum is only $\frac{1}{2}$ in., that of the femoral head is $\frac{3}{4}$ in. It is clear therefore that, even without unusual resistance from the soft parts, reduction of the dislocated head into this acetabulum is impossible. Moreover, even if it were possible to perform a partial reduction by manipulating the femoral head into a position accurately opposite the acetabulum, there is no projecting rim to keep the head in place.

AN ACCOUNT OF A CASE OF THYROID MALIGNANCY.

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THERE is now an abundant literature dealing with thyroid malignancy. The reproachful criticism of surgeons for their reluctance to study and report these cases made by Louis Wilson[1] in 1921 has been well answered by British workers, notably Dunhill and Joll. The air of mystery that surrounded these fascinating tumours has been dispelled and a simple and workable classification is now available. A correlation between the pathological findings and the clinical picture is now possible.

Joll's suggested classification[2] of the primary malignant tumours of the thyroid is as follows :—

1. Epithelial	*a.* Malignant adenoma *b.* Papilliferous carcinoma *c.* Carcinoma simplex
2. Connective-tissue tumours	*a.* Sarcoma *b.* Endothelioma *c.* Hæmangio-endothelioma
3. Mixed-celled tumours ..	*a.* Carcinoma-sarcomatodes *b.* Sarcoma-carcinomatodes
4. Teratoma	

At the present day the term 'benign metastasizing goitre' is universally condemned. The forty-four cases of thyroid metastases associated with so-called normal glands or benign thyroid tumours reported by Joll in 1923 in his Hunterian Lecture on "Metastatic Bone Tumours",[3] were reviewed in this light. Boyd[4] says of 'benign metastasizing goitre' that 'such a condition only exists in imagination'. The case reported here belongs to this group of the 'malignant adenoma'—an imperfect term, yet considered by Dunhill to be the best available at the moment.

The patient presented herself for examination at the General Hospital, Birmingham, in May, 1929, when 56 years of age—in that decade when malignant disease of the thyroid most commonly appears. A pulsating swelling was present in the right temporo-frontal region of the skull. The site of this can be seen in *Fig.* 417, which is a photograph taken a few months before death. The swelling had appeared seven months previously, and was considered by the patient to have followed an injury. The tumour was an inch in diameter, lateral to the external angular process, arising from the bone, and not attached to the overlying skin. Compression of the right common carotid artery abolished the pulsation, but did not cause any diminution in the size of the mass. The pre-operative diagnosis was 'sarcoma'.

First Operation (May, 1929).—Mr. Percival Mills exposed an extremely vascular tumour beneath the temporal fascia. The appearances were those of a malignant growth, and after a section had been taken, radium needles (4×5 mgrm. and 2×10 mgrm.) were inserted and the wound closed. A sharp radium reaction with some signs of overdose occurred after a total irradiation of 1680 mgrm.-hours.

Microscopical Examination of the Section.—The tissue consisted of thyroid vesicles containing colloid. There was very little deviation from the normal thyroid picture. There were areas of irregular proliferation, but the typical appearance of malignancy was not seen.

Fig. 417.—Photograph of the patient after removal of the thyroid tumour.

Progress.—After the radium treatment a marked decrease in the size of the tumour occurred. No note of a thyroid enlargement was made, although the patient on her latest admission to hospital declared that a small lump had been present in the neck since she was 16. Before she left the hospital the whole skeleton was X-rayed, but no other bony tumours were detected. The only abnormality noted was a dimness of the right frontal air sinus.

The patient was re-admitted on Dec. 9, 1931, two years and seven months after her previous admission, and therefore three years after the first appearance of the skull tumour. Her general condition was good. Her chief complaint was of pain in the right ear accompanied by a little blood-stained discharge. This was diagnosed as chronic otitis media, and had been treated conservatively in the Out-patient Department. There was sign of

recurrence of the skull tumour after an apparent disappearance for over two years. More interesting still was the presence of a tumour in the left lobe of the thyroid, solid, the size of a golf ball, apparently well-encapsulated, and freely movable. The patient refused to take any interest in this tumour, and declined operation in spite of the most energetic efforts to persuade her of its danger and of its being the source of the now recurrent skull metastasis. Her stout obstinacy won the day, and the only treatment she would allow was the further implantation of radium needles into the region of the cranial tumour. A second dose of 2940 mgrm.-hours led apparently to the complete disappearance of the tumour.

FIG. 418.—Photograph of cut surface of tumour. The typical appearance of a malignant adenoma. The definite capsule, the subcapsular lobules, and the central scarring are well marked.

She remained under out-patient supervision. The aural discharge continued and polypi appeared in the external auditory meatus. The skin over the skull metastasis ulcerated, presumably as a sequel to the radium treatment. The tumour in the left lobe of the thyroid showed no increase in size, and retained a remarkable degree of mobility.

On May 4, 1932, she was re-admitted for the third time. Mr. Stirk Adams, of the Ear, Nose, and Throat Department, reported upon her as follows: "There is an obturating polypus filling the right ear canal. The fact that with a mass so extensive there is no facial paralysis negatives a malignant disease of the middle ear, and I associate this ear infection with a grave right-sided nasal infection."

SECOND OPERATION.—After much persuasion, consent for excision of the tumour in the thyroid was obtained. The pre-operative diagnosis was 'metastasizing adenoma'. Through a collar incision with subsequent division of the infrahyoid muscles the tumour was dissected out with ease. *Fig.* 418 is a photograph of the cut surface of the tumour. The fibrous encapsulation and the central scarring, from which proceed trabeculæ enclosing areas of whitish tissue, are features invariably seen in a malignant adenoma. *Fig.* 419 represents a so-called 'adenoma' removed from a thyrotoxic patient, and is included for comparison with the malignant tumour.

FIG. 419.—So-called 'adenoma' removed from a thyrotoxic patient.

At the same time the aural polypi were removed by the curette. The patient made a satisfactory recovery. The photograph (*see Fig.* 417) summarizes her appearance, with the healed scar in the neck, the external auditory

meatus lightly packed with cotton-wool, and the circular area of ulceration overlying the site of the skull tumour.

MICROSCOPICAL APPEARANCES.—The histology of the aural polypi provided a great surprise. Dr. F. Lamb reported as follows on the microscopical appearances :—

1. *The Aural Polypus.*—The growth has the typical appearance of thyroid gland. Only certain areas show any unusual degree of epithelial activity, and these would ordinarily be described as adenomatous. Despite its metastatic nature the growth would not be considered malignant from its histological characters alone, but this is not very unusual in the case of thyroid tumours.

2. *The Thyroid Tumour.*—The growth has the general characters of a thyroid adenoma, but is considerably more irregular in its structure and arrangement than the specimen from the ear. The cells form solid columns, and their nuclei show enlargement and irregular chromatic figures. The appearances in this specimen are much more suggestive of malignancy than are those seen in the aural polypus.

X-RAY EXAMINATION.—A second complete radiological examination of the skeleton was carried out. This revealed an erosion in the skull between the right frontal to temporal region and a marked dimness in the right frontal air cells. No secondaries in any other bones or in the lungs were seen.

SUBSEQUENT PROGRESS.—This was not satisfactory. Headache and drowsiness were accompanied by strange behaviour. A month after the operation the scar in the frontal region showed definite bulging. A rapid recurrence of the aural polypi occurred. She was discharged to the Convalescent Hospital, where her condition steadily got worse. She died suddenly on July 24, 1932, after a sudden rise of temperature of a few days' duration.

POST-MORTEM EXAMINATION.—I was able to obtain permission for a limited examination. The body was extremely emaciated. In front of the right ear a circular area of ulceration marked the site of the first noticed tumour. The right external auditory meatus was blocked by a large aural polypus. A thin supple scar was present over the region normally occupied by the left lobe of the thyroid.

The cause of death appeared to be a terminal hypostatic pneumonia. The heart showed much myocardial fibrosis with extensive atheroma of the aorta. No abnormality was detected in the abdominal viscera.

The Region of the Thyroid.—The amount of thyroid tissue dissected out represented about one-sixth of the normal gland bulk. Very little of the left lobe could be found, and was presumably composed mainly of the removed 'adenoma'. No evidence of a neoplastic process could be found. No enlargement of the cervical lymph-glands was present, and no invasion of the jugular veins was noted.

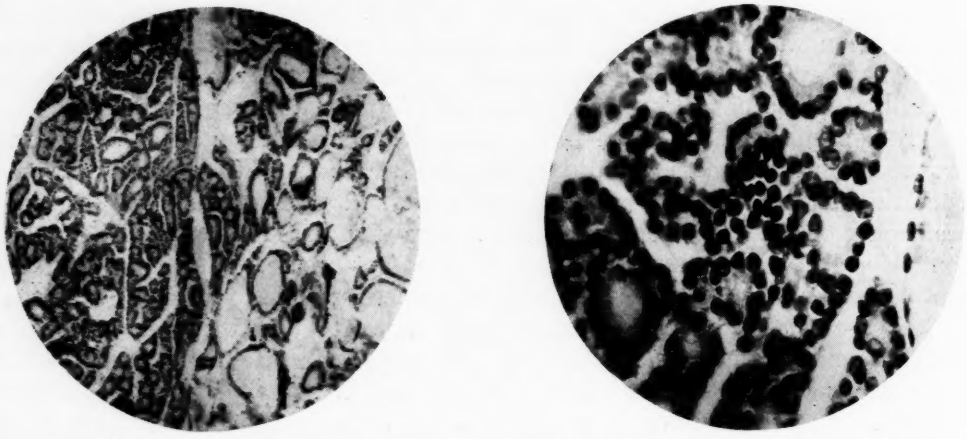
The Cranium.—On removal of the skull-cap a metastasis the size of a florin was found in the area of the right occipito-parietal suture growing from the inner table and attached to the dura. On removing the brain from the cranium a large tumour mass the size of an orange, but extremely nodular and irregular, was seen growing from the right petrous bone and indenting the temporo-sphenoidal lobe. This tumour was seen on dissection to be

continuous with the ulcerated patch in the temporo-frontal region and with the aural polypi in the external auditory meatus.

The Brain.—Apart from the intrusion of the tumour mass upon the right temporo-sphenoidal lobe, no abnormality was detected. The symptoms of increased intracranial pressure that existed in the last months of life were clearly due to the large size of the intracranial portion of the metastasis, which was the indirect cause of death. The size, nodularity, and destructiveness of the tumour quite condemn any such title as 'benign thyroid metastasis'. An extraordinary feature is that such an extensive lesion of the temporal bone could have failed to cause a complete right-sided facial paralysis.

COMMENTARY.

The case is a malignant adenoma, from which a metastasis killed the patient after it had existed for at least three and a half years. The 'adenoma' had existed since the patient was sixteen years old. An examination of



FIGS. 420, 421.—Low- and high-power views of the thyroid tumour to show area of malignant transformation and the intimacy of the cells with the thin-walled blood-vessels.

Figs. 418, 420, and 421 will reveal the changes associated with malignancy. From a central mass of fibrous tissue, trabeculæ, dense and in places calcified, run out to a true capsule, enclosing yellowish-white subcapsular areas. The arrangement may be compared with the cut surface of a pomegranate. The appearance of lobulation is striking. The strong capsule explains the free mobility of such a tumour, and its failure to infiltrate locally. Metastases occur through the blood-stream. *Figs.* 420, 421 are low- and high-power views of a portion of the tumour shown in *Fig.* 418. To the right in *Fig.* 421 a blood-vessel with an intimate lining of tumour cells can be seen.

A consideration of the photomicrographs supports the diagnosis of malignancy suggested by the macroscopic picture. The importance of examining several portions of an 'adenoma', so earnestly insisted upon by Dunhill, is well demonstrated by a glance at *Fig.* 420. The appearance of the right side of the field, so similar to that of normal thyroid vesicles, contrasts well

with the histological picture of malignant transformation seen in the left half of the photograph. The high-power view seen in *Fig.* 420 is from the latter area and shows the cell lining of the blood-vessels previously mentioned. The disorderliness of the cell arrangement is also apparent.

It will be seen, however, that a diagnosis of malignancy can be more easily arrived at by studying the macroscopic rather than microscopic structure.

The rate of malignant change was extremely slow. According to the patient's story the tumour had existed for over forty years. Metastasis occurred before any very noticeable increase in size had become obvious. Such a case must support the opinion of many surgeons that a prophylactic excision of all thyroid adenomata would lead to the disappearance of the 'malignant adenoma'. Joll considers that the presence of a metastasis does not exclude operation if the secondary can also be removed. In this case the rate of growth of the metastasis was partly controlled by radium. The discovery of another metastasis in the skull at the autopsy points to the difficulty of curing these cases once dissemination has occurred. The response to radium treatment is, however, noteworthy. The presentation of a secondary thyroid tumour as an aural polypus must be unique. The misleading nature of this has been alluded to in the case history.

I am greatly indebted to Mr. G. P. Mills, under whose care this patient was, for his permission and encouragement to publish these notes. Professor Seymour Barling kindly allowed me to use the photograph seen in *Fig.* 419, which represents a specimen removed from one of his patients.

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[2] Joll, C. A., *Diseases of the Thyroid Gland*, 1932, 302.
[3] Joll, C. A., *Brit. Jour. Surg.*, 1923, July.
[4] Boyd, *Pathology of Internal Diseases*, 1931, 532.

SHORT NOTES OF RARE OR OBSCURE CASES

A CASE OF HYDRO-ACCESSORY-URETER IN A CHILD OF TEN YEARS.

By G. GORDON BRUCE,

SURGEON, ROYAL ABERDEEN HOSPITAL FOR SICK CHILDREN.

In view of the extreme complexity of the embryologic processes which lay the foundation of the fully developed genito-urinary system, it is not surprising that anomalies in the urinary tract are more frequent than in any other part of the body. Although a supernumerary ureter is no longer a rarity, a series of 144 cases having been described by Braasch and Scholl,[1] it is unusual for such a ureter to reach an advanced degree of hydrops and to cause misleading symptoms in a young child.

History.—Peggy B., age 10 years, was admitted to the Royal Aberdeen Hospital for Sick Children on Feb. 20, 1932. Apart from attacks of measles, whooping-cough, and chicken-pox, she had enjoyed excellent health. Occasionally she had complained of frequency of micturition. On the day before admission she was seized with acute pain over the whole abdomen. The pain was most severe immediately before micturition. She felt sick but did not vomit.

On Admission.—The child looked flushed and ill. Her pulse-rate was 144, temperature 99·2°, respirations 36.

On Examination.—Her tongue was coated with a white fur. The abdomen did not move with respiration. Rigidity and tenderness were present over the hypogastrium, especially to the left of the middle line. Nothing could be felt in the abdomen, renal regions, or per rectum, and a specimen of urine disclosed no abnormality. The heart- and breath-sounds were normal. The clinical picture suggested acute appendicitis with pelvic peritonitis, and preparations were made for immediate operation.

Operation.—When the abdomen had been opened through a right paramedian incision, a small quantity of serous fluid welled up from the pelvis. The appendix, which did not appear inflamed or sufficient to account for her symptoms, was removed, and a further search instituted for the cause of the peritoneal reaction. On exploring the pelvis a round mass was found in the region of the left broad ligament. At first this was thought to be an inter-ligamentary cyst, but, on incising the peritoneum over the swelling, it was found to extend upwards into the left loin and downwards towards the vagina. It was cystic and shaped like a large German sausage. The left ureter was adherent to its posterior wall. The fact that this peculiar tumour

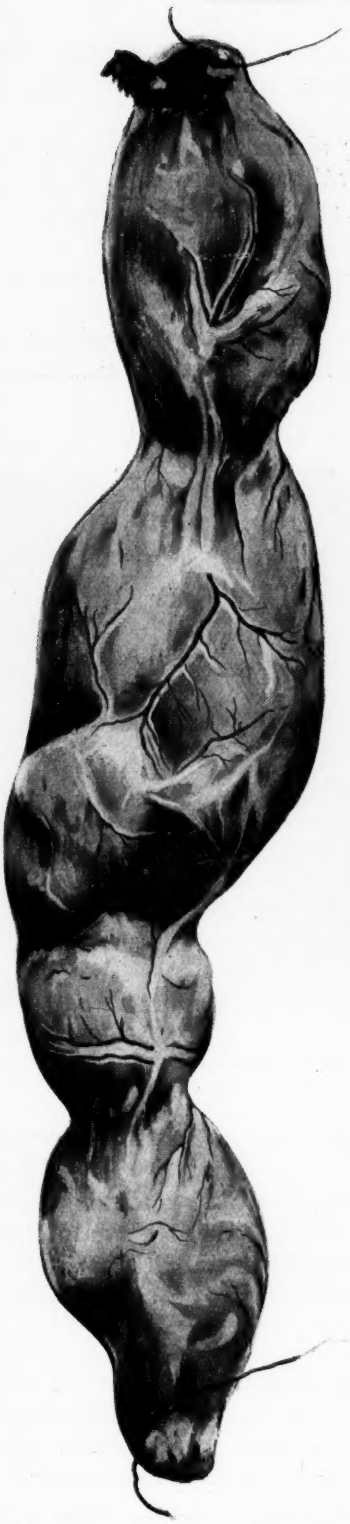

FIG. 422.—Accessory ureter after removal.

lay parallel to the ureter but crossed mesial to it to reach the vagina suggested a supernumerary ureter in a state of hydrops, for Kelly[2] has shown that the upper ureter always crosses medianwards to the orifice of the lower ureter. After the descending colon had been mobilized the cystic mass was found to extend from the inner side of the upper pole of the left kidney above to the vagina below. The kidney appeared perfectly normal in size and shape, and showed no sign of lobulation or subdivision. The normal or

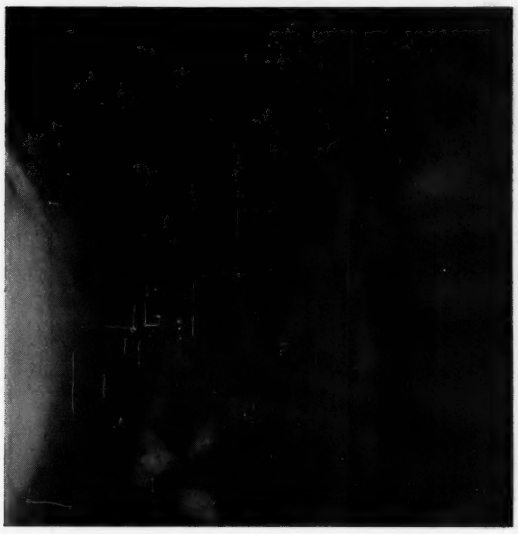

FIG. 423.—Ureter-catheter pyelogram: right side.

lower ureter issued from a pelvis which was slightly larger than usual. Ligatures were applied above and below, and the accessory ureter (*Fig.* 422) was removed intact. It was 16 in. in length, 4½ in. in circumference at its widest part, and was distended with yellow, turbid fluid. It did not seem necessary to bisect or remove the portion of kidney drained by the abnormal ureter. The colon was allowed to fall back into position, and the abdomen was closed in the usual manner.

SUBSEQUENT HISTORY.—The child made an uninterrupted recovery. On being questioned more closely after the operation, the mother stated that although the child had

appeared to have complete control of micturition previous to operation, she had noticed that her clothes were frequently damp and smelt strongly of urine.

On cystoscopy fourteen days later, nothing abnormal was seen in the bladder; both sides were catheterized. Ureter-catheter pyelograms showed: Right side (*Fig.* 423)—pelvis and calices normal; left side (*Fig.* 424)—mild degree of hydronephrosis with dilatation of primary calices—probably caused by the pressure of the abnormal ureter. Urea-concentration test showed: Right kidney—2·2 per cent; left kidney—2·5 per cent.

No organisms were grown from the peritoneal exudate. A specimen of fluid, withdrawn from the excised ureter, contained ammonium carbonate,

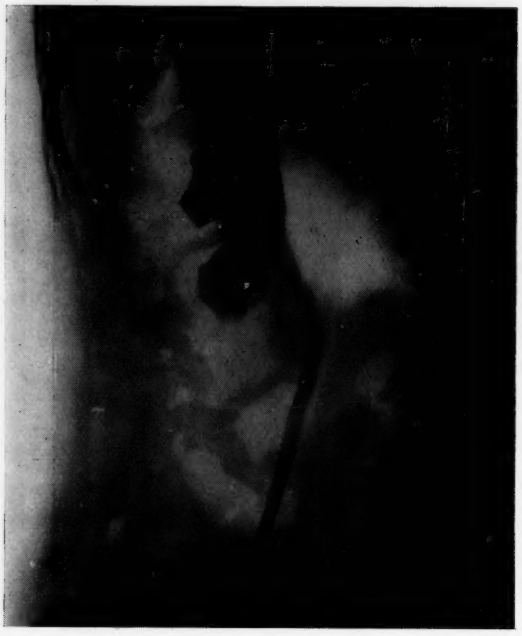

FIG. 424.—Ureter-catheter pyelogram: left side.

FIG. 425.—Ureter-catheter pyelogram: left side five months after operation.

0·3 per cent urea, a deposit of blood-cells and pus, but no casts or crystals. The culture was sterile.

In August the child was re-examined and was found in excellent general health. A ureter-catheter pyelogram (*Fig.* 425), taken of the left renal pelvis, showed that the hydronephrosis had almost disappeared since the accessory ureter had been excised.

DISCUSSION.

In cases of reduplication the kidney is commonly double or bifid, with the two pelves separate and always situated one above the other on the mesial surface of the kidney and each possessing fewer calices than normal. The present case corresponds more closely to one described by Huntington[3] in which one ureter terminated in a normal pelvis with the usual number of primary calices, the other in an incomplete pelvis.

The ureter develops as an outgrowth from the hinder end of the Wolffian duct near the cloaca about the fourth week. Complete duplication may result either from early splitting of the ureteral bud or from the development of two separate *anlagen*. Most frequently the ureters are found lying side by side. If the two buds come off the Wolffian duct simultaneously or nearly so, the two orifices will be found on a common ureteral ridge in the bladder, the ureter from the superior segment of the kidney terminating in the lower ureteral orifice. If a longer interval prevails, and if the Wolffian duct and ureter fail to shift anterior from the cloaca before the urorectal septum grows down to divide the rectum from the bladder, the accessory ureter may open into the rectum. If the ureter does not separate itself from the Wolffian duct but accompanies that canal caudalward, there results an abnormal connection of the ureter with those organs which arise from the duct, i.e., the vas deferens, seminal vesicle, and head of the epididymis; or else with the urogenital sinus and organs developing from this, i.e., the upper part of the urethra in both sexes and the vestibule of the vagina in women.

It would appear that a supernumerary ureter with anomalous implantation is more prone to stricture than one whose lower orifice is situated in the bladder. In the case described the gradually increasing degree of stenosis at the vaginal end probably masked the usual symptoms of incontinence and ultimately caused the extreme distension of the ureter which led to the onset of acute abdominal symptoms.

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[2] Kelly, *Diseases of the Kidneys, Ureters and Bladder*, 1914, i, 459.
[3] Huntington, quoted by Young, *Practice of Urology*, 1926, ii, 39.

AN UNUSUAL COMPLICATION OF A RICHTER'S HERNIA.

By J. B. G. MUIR,
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Strangulation of part of the circumference of the bowel, described by Richter, occurs more commonly through the femoral canal than any other hernial orifice, the sharp internal border of Gimbernat's ligament inflicting serious damage on the intestinal wall.

In a recent review on strangulated herniæ Frankau found that nearly 60 per cent of cases of Richter's hernia did not come under treatment until the condition had been present for forty-eight hours or more. The mortality is relatively high and has been quoted as being 19 per cent.

Such a hernia at the femoral canal may perforate at the site of strangulation and allow the bowel contents to escape into a pre-existing sac, which, presenting in the groin, may simulate a local abscess. The bursting of this superficially will form a fæcal fistula—or natural enterostomy. The following unusual case illustrates this sequence of events:—

A Chinese farmer, age 45, had occasionally suffered from sharp attacks

of pain in the right groin, which he found were eased by local pressure. (No tumour or swelling had ever been noticed.) Six months before admission to hospital he had suffered such an attack, but on this occasion had no relief, and after two days of great agony a tender swelling had rapidly formed in the groin. The swelling had been 'needled' by the local 'leech', and a lot of evil-smelling fluid had escaped, and also gas, with great relief of his symptoms. After a few days the local swelling and tenderness settled down, but he noticed that fæcal matter escaped from the wound several times a day, and he could only control it by a pad of wadding. No motions were passed by the rectum. Three months after the fæcal fistula had been established, he noticed a red fleshy protuberance hanging out of the fistula with an opening on the end of it, which discharged fæces. He described it as "a second penis which discharged his motions", and from the accompanying photograph (*Fig.* 426) it will be seen that the simile is not exaggerated. He

FIG. 426.—Patient's condition on admission. Prolapsed ileum can be seen depending from the femoral canal, the lighter areas being ulceration of the mucosa. The patient had been going about in this condition for three months, all his motions being passed from the apical orifice of the prolapse.

now began to experience pain and difficulty in controlling this protrusion, and came to the Tongshan Base Hospital in June, 1932, for treatment.

It was found that a prolapse of intestinal mucous membrane had occurred from the proximal opening of a 'natural enterostomy' at the right femoral ring, the enterostomy having probably resulted from the giving way of the strangulated portion of the circumference of the bowel in a Richter's hernia. The prolapsed mucous membrane was ulcerated and hung down, completely obscuring the distal opening of the intestine, which could only be found with difficulty. All motions were being passed by the opening situated at the apex of the prolapse, and the patient stated that he had lost a 'lot of weight', and felt weak.

I decided that the only satisfactory treatment would be laparotomy with resection of the 'herniated loop', which when isolated I proposed to remove via the hernial orifice. The patient agreed to operation, and a few days were spent in cleaning up the skin around the enterostomy opening.

OPERATION (June 6).—Ether anæsthesia. The enterostomy was carefully shut off by clamping waterproof sheeting and swabs to the circumferential skin. The patient was then placed in the Trendelenburg position, and the

abdomen was opened by a right paramedian sub-umbilical incision, with outward displacement of the right rectus muscle. A loop of ileum about two feet from the cæcum was found firmly attached to the internal aspect of the right femoral canal, the distal intestine below the loop's attachment being collapsed and much narrower than that proximal to the opening. Both the entering and returning limbs of the coil were divided about 6 in. from its attachment to the femoral canal, and both proximal and distal ends of each section were invaginated. Side-to-side entero-anastomosis was then carried out with some difficulty owing to the narrowness of the intestine distal to the hernia. This was left isolated, and the abdomen was closed. A circular incision was then made around the natural enterostomy and prolapsed ileum, and a ring of skin, together with the enterostomy and loop of ileum, was removed by easy dissection through the femoral canal (*Fig.* 427).

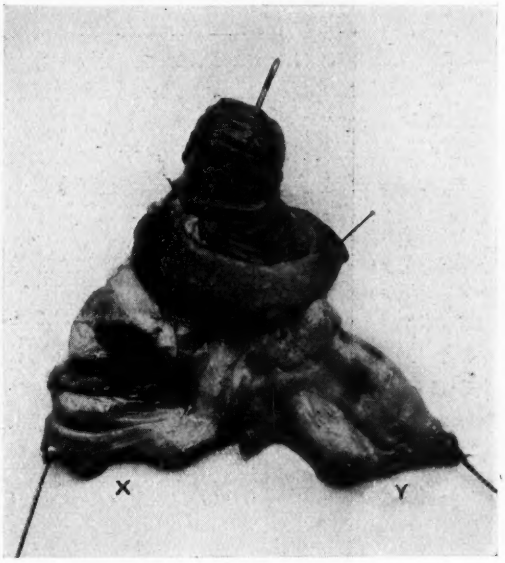

FIG. 427.—Prolapse and portion of ileum resected. A probe is in the apex of the prolapse. X is the proximal loop of intestine, and Y is the distal loop. The discoloured ring of excised skin was that surrounding the hernial orifice.

A drain was inserted down to the femoral canal, and the wound sutured. Good healing occurred, and the drain was removed on the fourth day. The first rectal motion for six months was passed on the second day. The patient made excellent progress until the third week, when some of his friends, eluding the vigilance of the nurse, smuggled some fruit into him on a visiting day. He partook of this well but not wisely, and contracted acute bacillary dysentery, from which he succumbed in three days, despite all treatment—a most disappointing end to an initially successful case.

This natural relief of a Richter's hernia by the formation of enterostomy must be somewhat rare, as also the prolapse of the mucosa from the proximal limb of the affected loop of intestine.

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CASE OF CONGENITAL CYSTADENOMA OF THE KIDNEY.

By A. W. FAWCETT,

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The case was referred to me on account of an attack of pain and the finding of a tumour in the left hypochondriac region. The patient, a trombone player in an orchestra, had felt the pain first whilst playing his instrument, and later found a swelling.

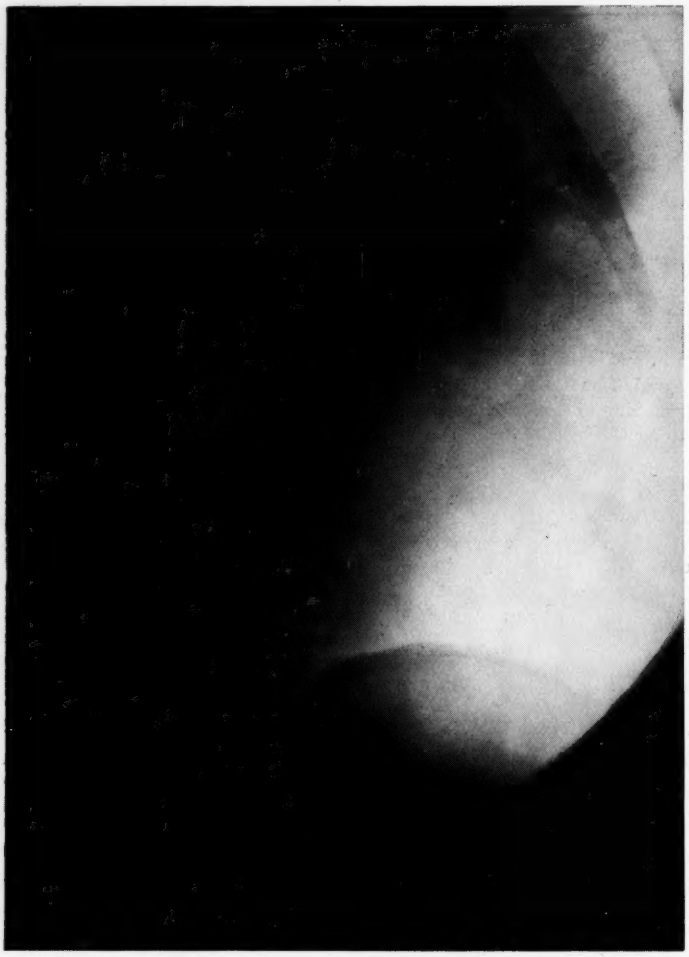

Fig. 428.—Pyelogram of left kidney showing filling defect at lower part of renal pelvis.

On examination the tumour was palpable and appeared to be a kidney which had apparently recently prolapsed; it seemed to be slightly enlarged. A pyelogram was taken with the result shown in *Fig.* 428. Chromocystoscopy revealed a slightly diminished flow of 'blue' from the left ureter.

An exploration of the left kidney was carried out, and on exposing the organ it was found to contain a rounded tumour in the lower pole. A nephrectomy was performed and the kidney hardened prior to bisection, which revealed the condition shown in *Fig.* 429—an encapsulated tumour divided into numerous polyhedral spaces containing clear fluid.

FIG. 429.—Macroscopic appearance of the kidney on bisection.

Microscopic sections show compressed remains of renal tubules in places. Dr. Harding, of the Pathological Department of the University, has kindly examined the specimen and is of the opinion that it is a congenital cystic adenoma of the kidney.

The case is of interest in two respects: (1) The cause of the prolapse was apparently partly occupational; (2) The rarity of the condition.

TRAUMATIC RUPTURE OF BILE-DUCTS: DRAINED: CHOLEFISTULOGASTROSTOMY.

BY G. H. EDINGTON,

VISITING SURGEON, WESTERN INFIRMARY, GLASGOW.

THE following case is an illustration of this serious surgical condition and of the means which were employed to effect a cure.

HISTORY.—Mr. G., age 24, civil engineer, and apparently a healthy young man, was seen with Drs. Crocket and Peill on Oct. 14, 1931. The story was that, while cycling on Sept. 16, he had a head-on collision with another cyclist. Both were on push-bicycles, and the other man was stooping over a low handle-bar. When the impact came the other man's head struck my patient in the hepatic region, and both riders were knocked off their cycles. The other man sustained injuries to his spinal column which laid him up for several months. My patient, who was motored home a distance of about

half a mile by a passing doctor, was greatly shocked. He rallied and suffered great pain in the lower abdomen, and jaundice quickly supervened.

The jaundice gradually faded during the third week, and the pain diminished so that towards the end of that week he felt able to begin some work. As the pain diminished he became conscious of a 'tightness' in the lower abdomen. This tightness gradually increased, spreading upwards towards the stomach, and a hardness was felt by the hand. Notwithstanding, he resumed work, travelling to his office by train and bus; but he was not able to do a full day's work because of 'heaviness' or lassitude. He had no appetite and swallowed liquids only, and the increasing tightness was temporarily greatly relieved by vomiting. The vomitus was said to be yellow in colour and intensely bitter. His bowels were moved several times daily by Eno's salt; the motions were greyish-white and soft.

On the fourth day after resuming work he strained himself while boarding a tram-car which started off suddenly. He felt a snap 'as if something had given way' in the epigastrium. From that time there was a very rapid increase of the tightness in the upper abdomen, and epigastric swelling appeared. Co-incidently, the disappearance of the jaundice became more rapid. Two days later he had to cease work altogether, because increasing heaviness was overcoming him. After being two days at home he was sent into the nursing home on Oct. 14, 1931 (twenty-nine days after the accident).

On Examination.—The patient was able to walk along the corridor to his bedroom. His condition on examination was: face pallid; abdomen distended and flanks tympanitic; liver dullness not obscured; stomach note not very clearly obtained; globular projection in epigastrium, fluctuant, dull on percussion, and not definitely tender. Temperature 99°, pulse 92, respiration 28. The signs suggested a collection of fluid in the lesser sac, or within the sheath of the pancreas.

Operations.—On Oct. 15 a left paramedian, supra-umbilical, exploratory laparotomy was performed. Subperitoneal fat bile-stained; omentum presented (whether lesser or great, not determined) and was incised; behind it was a thin-walled cyst, on opening which a torrent of dark, greenish, bile-stained fluid gushed forth. The exploring finger found a large cavity, roofed by liver on the right side; on the left the finger could not reach the limiting wall. Cyst-wall sutured to skin, and rubber tube and iodoform gauze packing inserted into cavity. Dr. Ernest Dunlop, of the Western Infirmary Clinical Laboratory, reported that no trace of pancreatic fluid was found in the specimen.

The operation was followed by a profuse discharge of bile from the wound, and on the second day the administration of ox-bile 'Tabloids' was commenced. The gauze packing was removed on the fifth day, and the wound allowed to contract down to a fistula. Screening on the twenty-third day showed the stomach situated below the level of the fistula, and on the thirty-third day the abdomen was opened by a right paramedian laparotomy with the object of searching for and dealing with the rupture. The viscera were found to be obscured by thickened omentum through which could be felt the hard and semi-globular right lobe of the liver. Further exploration was desisted from

in order to obviate the risk of damaging the fistulous track. The fistulous orifice in the original wound was, along with a small portion of surrounding skin, then freed and the old wound opened up. The stomach was found behind non-adherent omentum. The fistulous orifice and attached skin were then anastomosed to the anterior surface of the stomach (*cholefistulogastrostomy*) and the junction covered with omentum. Both right and left laparotomy wounds were closed without drainage. The patient was allowed out of bed on Dec. 7, twenty days after the anastomosis operation, and a few days later he went home. His appetite was good and stools were normal. I did not see him again till May 6, 1932, when he came up to me at a social function. He was then so stout and well that I did not recognize him.

During the period of his residence in the nursing home, heavy night sweats and some irregularity of temperature were a marked feature of his case. He told me that this manifestation had commenced with the accident, and it continued after he left the home, with gradually diminishing severity till the middle of February, when it finally ceased.

Subsequent History.—I next saw the patient early in July, when he furnished me with the following particulars :—

He resumed business on Feb. 25, and except that he avoids lifting weights, he is quite as fit as he was before the accident. His business is largely office work and interviewing clients ; but it includes a fair amount of looking at outside work in course of construction. This entails his ascending ladders and scaffolding, going down below bridges, and wriggling into corners.

His general appearance is good, and he is alert bodily and mentally. He had lost 2 stone before his operation, but he is back to normal. He has absolutely no complaints as regards his health. He eats ordinary food well, his bowels act regularly without his requiring to take medicine, and he has no discomfort of any kind in the abdomen. Examination of the abdominal wall shows both laparotomy scars ($4\frac{1}{2} \times \frac{1}{2}$ in.) sound and without any trace of yielding. Both, however, show the coarse appearance to which the term 'keloid' is sometimes applied.

Summary.—Accident followed by partial recovery and resumption of business ; increasing distress from gradual accumulation of bile in (or around) lesser omentum ; collection drained and external fistula instituted four weeks after accident ; transplantation after thirty-second day of fistula into stomach —*cholefistulogastrostomy* ; recovery.

Unlike Mr. Waugh[1] in his recent highly interesting paper on transplantation of external biliary fistula, I had to forbear subjecting the patient to exploratory dissection, although such was my intention when I began the second operation. It is disappointing not to know the precise anatomical details of the rupture, but disappointment in that respect is counterbalanced by the happy termination of the case.

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[1] *Brit. Jour. Surg.*, 1930–31, xviii, 581.

PRIMARY BENIGN NEOPLASM OF THE URETER.

By G. A. B. WALTERS,

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Primary tumour of the ureter is a rare condition; and of the published cases the majority have been malignant.[1] Melicow and Findlay,[2] reviewing the cases of simple tumour in a recent communication, found that 28 had been recorded and added one of their own.

History.—E. T., a married woman aged 58, was admitted to hospital in May, 1932. For about nine weeks she had suffered from attacks of pain in the right loin, lasting about two hours and radiating down towards the groin. The pain was never very severe or colicky in nature. For about seven weeks she had noticed a lump in the right side of the abdomen. Micturition was habitually somewhat frequent, and on one or two occasions the urine had been blood-stained. No history of previous ill health.

On Examination.—The abdomen showed some fullness on the right side, where a large tumour could be felt in the loin; it was smooth, mobile, and easily separated from the liver. The patient was rather thin, but except for some bad teeth she was in good condition. Blood-pressure and blood urea were well within normal limits. The urine contained a few red blood-corpuscles but showed no other abnormality. Radiological examination disclosed no evidence of calculus.

Cystoscopic examination revealed a normal bladder and left orifice; at the right orifice a small tag of growth was presenting, and I was unable to pass a ureteric catheter on that side; the attempt did not cause any marked hæmorrhage. After intravenous indigo-carmine there was a good excretion of dye from the left ureter in five minutes. No dye was seen from the right side in fifteen minutes. Uroselectan B showed that the pelvis and calices of the left kidney were normal; there was no excretion visible from the right kidney.

Operation.—A provisional diagnosis of neoplasm of the right kidney pelvis with secondary deposit in the ureter was made, and operation performed on May 25. Under spinal anæsthesia (2½ c.c. Duracaine), a large hydronephrotic kidney was delivered with considerable difficulty, and the ureter was seen to be very tortuous and dilated; it was divided low down with the cautery and the kidney was removed.

As owing to the dense adhesions this part of the operation had taken rather a long time, a further 2 c.c. of Duracaine were then given. Next the bladder was exposed through a sub-umbilical incision; the right side was dissected clear, and the remainder of the ureter, together with a small wedge of bladder, including the ureteric orifice, were removed.

The bladder was drained suprapubically and through the urethra, the patient returning to the ward in good condition. With the exception of a mild attack of pyelitis convalescence was uneventful. When seen in the out-patient department three months later there was no evidence of recurrence.

PATHOLOGY.—Macroscopically the kidney showed a large hydronephrosis, little normal tissue remaining. The ureter was patent in the upper 6 in., though tortuous and dilated to a diameter of 1 in. In the lower part the lumen was occluded by growth (*Fig.* 430) as far as the orifice, through which the tumour was starting to protrude.

Examination of the section seen in *Fig.* 431 showed a simple papilloma covered with epithelium of transitional character. There was no evidence of malignancy.

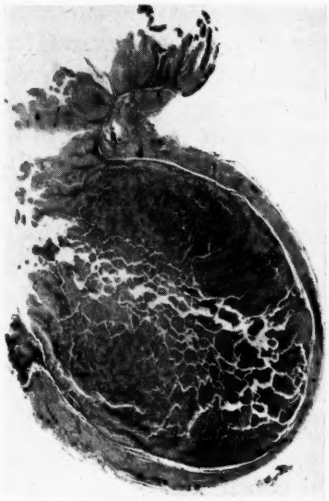

FIG. 430.—Showing the growth filling the lumen of the ureter.

FIG. 431.—Greater magnification to show the structure of the tumour. (× 75.)

Commentary.—Judging from a survey of the literature this case may be regarded as presenting the more typical features of a tumour in this situation. That is to say, the growth was situated at the lower end of the right ureter, and the patient complained of renal pain, hæmaturia, and a palpable swelling. The majority of the recorded cases, however, have occurred in males.

The small amount of hæmaturia is somewhat unusual. In a number of published cases the diagnosis was suggested by profuse bleeding on attempting to pass a ureteric catheter.

It is of some interest to note the extensive procedures rendered possible by spinal anæsthesia, without undue shock to the patient. Were this form of anæsthetic not available, a two-stage operation as performed by Thomson-Walker[3] and others would probably give a greater margin of safety.

I am indebted to Mr. W. F. Neil, Honorary Surgeon to the General Hospital, Nottingham, who performed the operation, for permission to publish this case.

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[3] THOMSON-WALKER, J. W., *Proc. Roy. Soc. Med.* (Sect. of Urol.), 1921, xiv, 25.

INTERNAL HERNIA THROUGH CONGENITAL APERTURE IN MESENTERY: STRANGULATION.

By J. C. F. LLOYD WILLIAMSON,

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INTERNAL herniæ are relatively uncommon. They may be said to comprise: (1) Hernia into peritoneal fossæ, especially paraduodenal; (2) Hernia through foramen epiploicum; (3) Hernia through aperture in (*a*) omentum, (*b*) broad ligament, (*c*) falciform ligament, (*d*) mesocolon, (*e*) mesentery. Of these, probably the last type is the most rare, few cases having been recorded.

Romankevitch[1] quotes two cases of the mesenteric type as well as one mesocolic. Hamilton Bailey[2] describes a personal case of the mesenteric type, and he has assisted also at a second case: it is interesting to note that in both these cases reduction was facilitated by aspirating some of the contents of the strangulated loop. Folliasson[3] at the end of his extensive article on internal herniæ mentions the type; he states that the hiatus is probably congenital, and usually occurs near the cæcum (as in this case). He quotes one case only, a patient of Lafourcade; no record of the publication of this case can be found.

The present case is that of a youth of 17, who was admitted from the country at 5 a.m. on a Sunday morning complaining of very severe abdominal pain.

HISTORY.—The patient had been in normal good health till 11 p.m. the night before, when there was a rapid onset of severe generalized abdominal pain, which at times made him roll about. He vomited five or six times. The bowels had been open that day, but not after the onset of pain. Pain persisted and increased. He felt as if he wished to bring up wind, but could not. Micturition was normal. There was no history of a previous attack.

Past History.—Left orchidectomy at the age of 3, probably for tuberculosis.

ON EXAMINATION.—The patient looked grey and ill: temperature 97·4°, pulse 78, respirations 20. At intervals he was absolutely unable to be still, but rolled about in agony. The tongue was thickly furred. He pointed to the lower abdomen as the site of the pain, and palpation elicited rigidity and tenderness here, most marked in the right iliac fossa, where there was slight distension and a doughy sensation on pressure. Rectal examination showed no abnormality. The left testis was absent, the right somewhat enlarged and accompanied by a small hydrocele of the tunica vaginalis. The hernial orifices were normal. Urine showed some acetone and a considerable amount of sugar (this disappeared immediately after operation), but no albumen or organisms.

A provisional diagnosis was made of acute appendicitis, probably with a concretion giving rise to colic, and morphia and warmth were applied to the patient.

OPERATION (6.45 a.m.).—On opening the abdomen through a right lower paramedian incision, free blood-stained fluid exuded. On looking further it

was seen that 4 ft. (as measured afterwards) of the lower ileum had passed from left to right through a rounded aperture 2 in. in diameter in the distal part of the mesentery and was strangulated. The constriction was very tight, but by enlarging the hole slightly and with great care the hernia was reduced. The bowel was black, and did not recover at all, so the terminal 5½ ft. of the ileum were resected and a side-to-side ileocæcostomy was performed. The gap in the mesentery was closed, and then the abdominal wound.

Subsequent Progress.—The condition was critical for the first twelve hours, but after that the patient made a rapid recovery, and now, nine months later, appears to be in good health and is gaining weight rapidly.

Comment.—Accurate diagnosis of this condition does not seem to be within the realms of possibility, but the acuteness of onset, the severity of the pain, and the vomiting should have suggested an acute internal strangulation or torsion of bowel. The origin of the aperture is obscure, but it would seem to be congenital.

I am much indebted to Mr. J. R. H. Turton for his kindness in allowing me to publish this case.

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AN UNUSUAL ACCIDENT IN GASTRECTOMY.

By IAN M. ORR,

SURGEON, LONDON MISSION HOSPITAL, NEYYOOR, TRAVANCORE, S. INDIA.

An elderly man giving a typical history of gastric carcinoma was admitted under my care, and after suitable preparatory treatment was operated upon. An infiltrating carcinoma involving the pyloric portion of the stomach was found (*Fig.* 432), and it appeared to be adherent to the pancreas but not to involve it. Glands were found along the lesser and greater curvatures, but no secondaries were found in the liver. It was considered to be a suitable case for a Pólya gastrectomy, but the adhesions to the pancreas presented a difficulty.

Operation.—The duodenum was divided (*Fig.* 433) and the distal end closed. After dividing off the gastrohepatic and gastrocolic omentum and exploring the relations of the growth to the lesser sac and pancreas, it was decided to cut away a portion of pancreatic tissue with the stomach, to make the eradication of the disease as complete as possible. The coronary artery was secured and glands in relation to it were dissected off, and the gastrectomy was completed in the usual manner by the Pólya method. It was then found that a duct was cut and was discharging a few drops of clear fluid. A probe was passed up and found to lead into the body of the pancreas and along the course of the main duct. As the cut end was evidently the main

duct of the pancreas, some attempt at repair was obviously indicated. A fine rubber tube 3 in. long was passed into the duct, and secured with No. 00 catgut, leaving the ends long. The stump of the duodenum was brought into relation with it without much trouble, and a slit 1 in. long made through the seromuscular coat. The seromuscular layer was then dissected up slightly

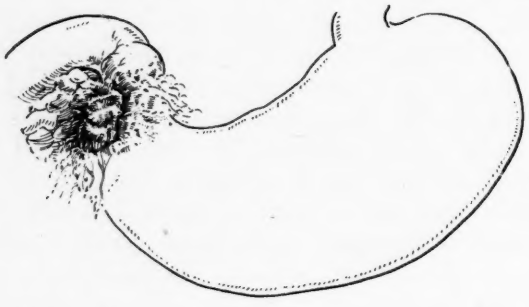

FIG. 432.—Cancerous ulcer adherent to pancreas.

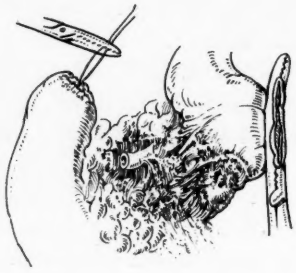

FIG. 433.—Duodenum divided and stomach turned back showing cut pancreatic duct.

on either side to form a trough, and a stab puncture made into the lumen at the distal end of the trough. Into this the rubber catheter was introduced, and the long ends of catgut from the pancreatic duct were passed by means of an intestinal needle into the lumen and out through all the coats of the bowel $\frac{1}{4}$ in. lower down. By putting traction on these two ends of catgut, the pancreatic duct and rubber tube were drawn well into the lumen of the duodenum and secured by tying the two ends together outside the bowel. The remainder of the duct with the tube inside was caused to lie along the trough and buried by bringing the seromuscular coats together by continuous catgut suture after the manner of a jejunostomy. A second layer of suture covered all this in, and some omentum was sutured over it as an additional safeguard. (*Fig.* 434.) A cigarette drain was introduced and the abdomen closed in layers.

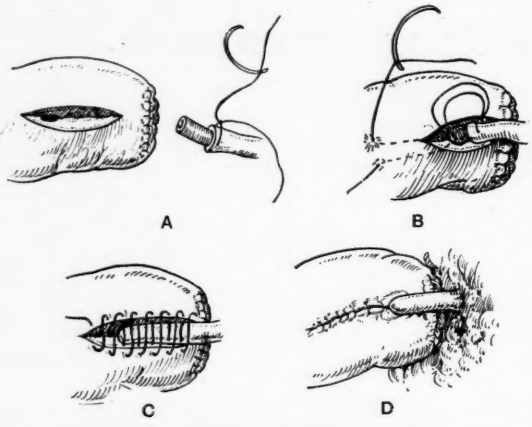

FIG. 434.—A, Duct with rubber tube inserted and trough cut in duodenal stump; B, Insertion of tube and duct; C, First layer of sutures; D, Operation completed, showing duct implanted in duodenum.

AFTER-TREATMENT.—The drain was removed in forty-eight hours, some serous fluid only having escaped along it. The patient was treated as for any abdominal operation.

RESULT.—He made an uninterrupted recovery and passed fully digested stools from the beginning, and left hospital well and with a moderate appetite at the end of one month, having put on weight since the operation. (The

rubber tube was never found in the motions, though the nurse was instructed to look for it.)

Comment.—Interest in the case lies in the rather unusual accident—namely, division of the main duct of the pancreas during an operation for carcinoma of the stomach, and in the fact that pancreatic juices must have drained normally into the duodenum through the new opening, and in spite of the absence of a valve action no pancreatitis developed and the patient was well at the end of one month.

TORSION OF THE GALL-BLADDER.

By JAMES F. MURRAY,
KING'S CROSS HOSPITAL, DUNDEE.

Torsion of the gall-bladder in the male is sufficiently rare to make each case worth recording. I can trace only two other published cases[1, 2]; the other 15 cases which I have found in the literature have occurred in female patients.

History.—G. W., male, age 83 years, was seized by sudden acute pain in the right upper abdomen on June 26, 1932. This he attributed to over-indulgence in ice cream a few hours previously. The pain continued unabated

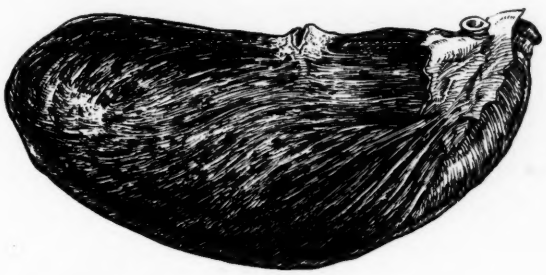

Fig. 435.—Gangrenous gall-bladder. The perforation was due to an accidental rupture while examining the organ after removal.

and was accompanied by frequent vomiting, nausea, and anorexia. Pain did not radiate or change in position. There had been no movement of the bowels, but he passed flatus freely and had no urinary disturbance. He was admitted to Dundee Royal Infirmary on June 28, 1932. There was no previous history of dyspepsia, jaundice, or colic.

On Admission.—The temperature was 98·6°, pulse 88, respiration 24, and the leucocyte count 22,000. The abdomen was retracted, respiratory movement restricted, and there was free fluid in the flanks. The epigastrium and right hypochondrium were exquisitely tender and very rigid. Liver dullness was rather increased, but owing to rigidity no abnormal mass could be felt in the right upper abdomen. A provisional diagnosis of acute cholecystitis was made.

Operation.—The abdomen was opened through a right upper paramedian incision. Upon opening the peritoneum a large quantity of dark

blood-stained fluid escaped and a tightly distended gangrenous gall-bladder (*Fig.* 435) immediately presented in the wound. Owing to the unusual mobility of the organ cholecystectomy was very easily performed. No stone was found in the cystic or common ducts.

PATHOLOGY.—The gall-bladder was a deep purple-black colour with thickened walls containing extravasated blood. It was tightly distended by blood and bile, but contained no gall-stones. Peritoneum surrounded it completely and was reflected off at the junction with the cystic duct. At this point the pedicle (consisting of mesentery, cystic duct, and blood-vessels) had undergone a complete clockwise torsion of one and a half turns.

SUBSEQUENT HISTORY.—The patient recovered from the operation to the extent of being up and out of bed. He then developed retention of urine, and later a severe œdema of the lung, from which he died six weeks after onset of illness.

Commentary.—The chief interest of the case lies in its occurrence in a male subject. Otherwise it corresponds closely to previous recorded cases (acute pain of sudden onset in the right upper abdomen accompanied by frequent vomiting and followed by rigidity in the right hypochondrium). In no case that I have traced was shoulder pain or jaundice noted. As in this case, a diagnosis of acute cholecystitis was usually made.

It is noticeable, too, that in nearly all cases remark has been made upon the ease with which cholecystectomy was performed by reason of the freely mobile nature of the gall-bladder.

The first recorded case was that by A. V. Wendel,[3] but in this case there was no gangrene, and perforation of the gall-bladder had occurred. By far the majority of cases occur in elderly females, and the only recorded cases I can trace as occurring in males are those noted by Costantini[1]—a male, age 42 years, who made a complete recovery, and by Holden[2]—a male age 49 years, who also recovered.

I have to thank Mr. John Anderson, D.S.O., F.R.C.S., for permission to publish this case, and Dr. D. Henderson for the reproduction of the specimen.

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SQUAMOUS-CELLED CARCINOMA OCCURRING IN A PHARYNGEAL POUCH.

By F. C. W. CAPPS and T. P. DUNHILL.

Carcinoma in a pharyngeal pouch is a rare condition ; a search of the literature at the Royal Society of Medicine has failed to reveal any record of such a case ; the notes of the following case are therefore of interest.

The patient (C. P.), age 59, was first seen (by F. C. W. C.) early in May, 1932, and was admitted to the Throat Department of St. Bartholomew's Hospital on May 29. He complained of increasing difficulty in swallowing food, associated with a swelling of the left side of the neck as food was taken. Difficulty in swallowing had been present since 1902—that is, for thirty years—and he had been accustomed to 'bring back' a certain amount of food taken during the previous twenty-four hours. This gave relief until the next meal was taken. The patient also stated that his father and his father's eldest brother suffered from a similar condition, and he is said to have a female cousin of about 60 years of age still living with a pouch. This lady has not been traced, but endeavours are being made to find her. He stated that he could remember his father bringing up blood for some years before his death at the age of 75.

Fig. 436.—Section of squamous-celled carcinoma in pharyngeal pouch.

There was no loss of weight six weeks before admission, but at that time he brought up about 3 oz. of clotted blood, and this had happened on several occasions since. He had then started losing weight. Five days before admission he became completely obstructed and obtained no relief from vomiting.

A gastrostomy was performed two days later on account of the urgent need for nutrition. After feeding for nine days by means of the gastrostomy, the patient had improved sufficiently to permit a pharyngoscopic examination being made. This showed the orifice of a pharyngeal pouch almost completely blocked by a mass which was pushing up towards the orifice of the pouch from within it. Apart from the pouch and its contents, the pharyngeal wall appeared normal, but the normal lumen of the œsophagus could not be identified. A piece was nipped off through the pharyngoscope from the material in the pouch. This on examination proved to be a squamous-celled carcinoma (*Fig.* 436).

An X-ray examination carried out two years previously at the Duchess of Bedford's Hospital at Woburn showed the presence of a pouch much smaller and of regular outline both laterally and antero-posteriorly. The X-ray examination carried out by Dr. J. V. Sparks (June 4) showed the presence of a pharyngeal pouch. In the antero-posterior view (*Fig.* 437) a filling defect was seen in the middle third of the left side. A lateral film showed the filling defect to be situated anteriorly (*Fig.* 438). The growth was therefore situated in the left antero-lateral wall of the pouch, and seeing that it reached rather lower than the upper margin of the arch of the aorta, the wall of the pouch at the site of the growth was probably in contact with the left carotid artery and the junction of the internal jugular with the left innominate vein. The

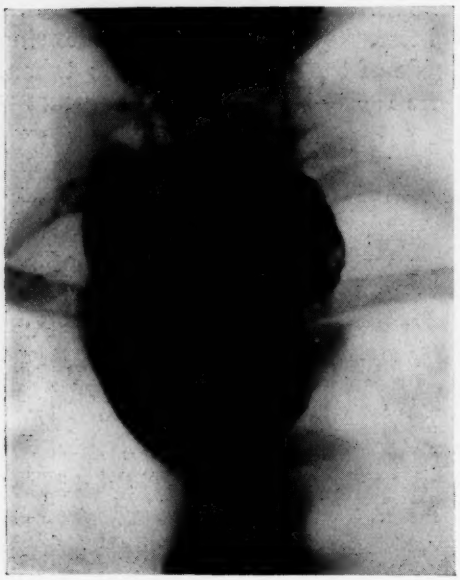


FIG. 437.—Antero-posterior view of pharyngeal pouch.

FIG. 438.—Lateral view of pharyngeal pouch.

practicability of its removal would depend on whether the growth had transgressed the wall and involved these vessels. The teeth were very bad, and a number of these were extracted on June 13.

The patient was wasted; there was an offensive smell. On attempting to swallow fluids a swelling on the left side of the neck became obvious. Pressure over this caused its contents to flow out through nostrils and mouth.

It has become my practice (T. P. D.) to operate upon simple pharyngeal pouches in one stage, although in the earlier cases the two-stage operation was employed. The one-stage operation has always gone smoothly, and the layers of the neck of the sac are much more readily recognized and more cleanly dealt with at a first operation than at a second. Naturally the patient is more comfortable with a single-stage operation. With a carcinoma in the pouch, its growing edge close to the orifice, and the certainty that the wall at the base of the growth must be deeply involved if not penetrated, it was

scarcely possible to consider a two-stage operation. The term 'one-stage' or 'two-stage' is used in connection with the operation upon the pouch itself; it has no reference to a preliminary gastrostomy. In a patient with a simple pouch which has become so large that swallowing is practically impossible, gain in weight and improvement in general condition follows a gastrostomy. The patient—also a patient of each of us—with the pouch illustrated in *Fig.* 439 had become greatly emaciated. Nutriment given through a gastrostomy improved his condition so much that feeding in this way was continued for five weeks and then the operation was performed without anxiety. In the present case improvement in the general condition following the gastrostomy was so slight that the risk of operation had to be undertaken without delay if the patient was to be helped.

FIG. 439.—Œsophageal pouch.

OPERATION NOTE (June 23).—The superficial area of the neck was infiltrated with local anæsthetic solution containing 1–200,000 adrenalin. Nitrous oxide and oxygen was then given by Mr. C. L. Hewer. The sac was defined through the usual curved incision, the lower pole of the sac being freed and delivered by the gloved finger. An area about 1 in. in diameter at the base of the ulcer was thin and almost necrotic. This was attached to the origin of the carotid artery just within the upper opening of the thorax, and in separating it a little of the contents of the pouch escaped into the wound. The pouch was freed up to its neck and opened there. An œsophageal bougie was passed through the pharynx under vision into the œsophagus. The pouch was cut away by dividing the muscular layer, stripping up a cuff, and dividing the submucosa and mucosa. At one point the growth was so close to the aperture that a little of the pharyngeal wall was taken with it as a precautionary measure. The opening was sutured in two layers. The wound was packed with flavine and paraffin gauze because of the soiling.

DESCRIPTION OF THE PART REMOVED.—This was a sac measuring 5 in. by 4 in., oval in shape, with a wall smooth on the outside, the wall of the sac being perforated at one place near the lower pole. It was filled with a friable evil-smelling growth. A section from this shows it to be a squamous-celled carcinoma, as illustrated in *Fig.* 436.

SUBSEQUENT HISTORY.—The patient remained reasonably well for eight days, when blood appeared through the dressing. This was treated by packing and pressure until it became obvious that its origin should be sought for. This was an hour after the commencement of the bleeding. The vessel, a single small artery, was quickly found and ligated. The cavity in the neck appeared clean. The patient had lost too much blood and died almost immediately.

UNUSUAL DIFFICULTIES IN THE DIAGNOSIS OF A DIAPHRAGMATIC HERNIA.

By A. GRAHAM BRYCE,
SURGEON, PARK HOSPITAL, DAVYHULME;
AND E. D. GRAY,
RADIOLOGIST, PARK HOSPITAL, DAVYHULME.

The readiness with which most cases of diaphragmatic hernia can be diagnosed depends on the presence in them of portions of the hollow viscera, the recognition of which by radiography is facilitated when barium is introduced into them in the form of a meal or enema. In the case here described, however, these measures failed to establish a diagnosis, and the nature of the condition remained in doubt until it was demonstrated at operation. The following are notes of the case:—

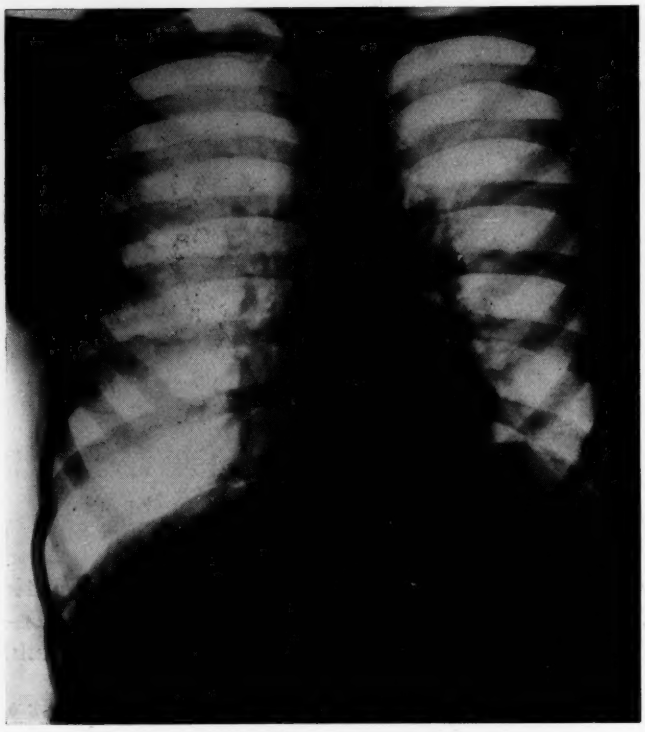


Fig. 440.—Antero-posterior view in erect position.

W. T., male, age 7, was admitted to the Park Hospital, Davyhulme, on Aug. 8, and again on Oct. 21, 1929. His illness commenced after a fall from his bicycle, and was characterized by abdominal pain and vomiting at the onset, mild febrile attacks, a troublesome cough, and the presence of a persistent area of dullness at the base of the left lung.

X-ray examination of the chest showed a semicircular opacity at the left base posteriorly. Its lower border was continuous with the shadow of the diaphragm, and its upper, convex border projected into the lung field. In addition a small abnormally translucent area was observed lying in front of the dense opacity (*Fig.* 440). It was thought that the appearances were due to diaphragmatic hernia—the opacity indicating the spleen and the translucent area representing a portion of the gas-filled splenic flexure. To confirm this view further examinations by means of an opaque enema and an opaque meal were carried out. These showed the

colon and stomach respectively to be in normal position, and we were therefore misled into doubting the original interpretation.

After his discharge from hospital in November, 1929, the patient attended from time to time for clinical and radiological observation during the ensuing twelve months. Dyspnœa on exertion, recurrent cough, and occasional pain in the abdomen and left side of the chest persisted. These symptoms were not severe, and the general health and nutrition were maintained quite satisfactorily.

On Nov. 12, 1930, the patient was re-admitted to hospital. The dullness at the base of the left lung was unchanged. Neither further X-ray investigation nor bronchoscopy threw any new light on the case. The symptoms, though mild, had persisted for more than a year and the nature of the lesion remained obscure. For these reasons an exploratory thoracotomy was undertaken on Jan. 14, 1931, under intratracheal gas-oxygen-ether anæsthesia. The eighth left rib was resected and the pleura opened. Inspection of the left cupola of the diaphragm revealed a hernia of the size of a small orange. The sac was serous and of a thickness which suggested a fusion of the peritoneum and pleura. The hernial orifice was completely surrounded by muscular fibres and was nearly circular in shape, its greatest (antero-posterior) diameter being about 2½ in. A small opening made in the summit of the sac confirmed the presence in it of the upper half of the spleen and the absence of other viscera. This opening was ligatured and the sac invaginated into the peritoneal cavity. The edges of the hernial orifice were sutured in two layers on the thoracic aspect in the antero-posterior line. Water-seal drainage was arranged by a tube through a separate opening in the tenth intercostal space. For two days after operation the patient was considerably shocked, but from the third day, in spite of a small axillary pleural effusion, he made a rapid convalescence, and he has remained well up to the time of the last examination on June 1, 1932.

DISCUSSION.

The importance of the case lies in the difficulty of interpretation of the X-ray appearances. If the nature of the lesion could have been accurately diagnosed, the symptoms produced by it would not have justified operation at the time when this was undertaken; it would have been sufficient to keep the child under observation.

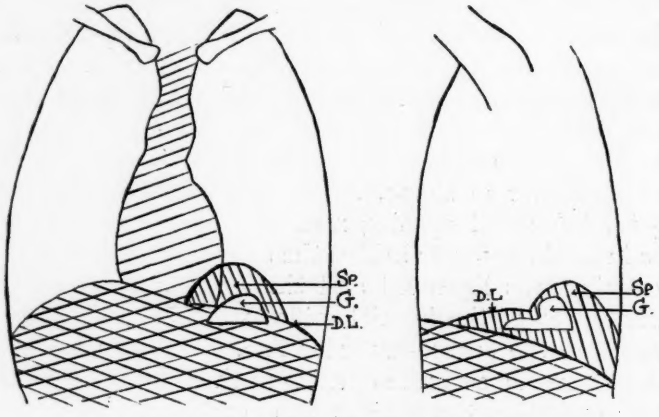
At the time of operation, at any rate, the spleen was the only viscus present in the hernial sac. This organ quite frequently forms part of the contents of a diaphragmatic sac, but reference to all the available recent literature has failed to bring to light a case in which it was present alone. The X-ray films show that the operative findings do not represent the permanent state of affairs, and further reference will be made to this point.

From the surgical point of view, the case presents one other feature of interest—the age of the patient. Truesdale[1] says that, at the time of writing, the total number of patients under ten years of age reported in the literature as operated on reached 22, with a total mortality-rate of 41 per cent. He adds another successful case of his own to the list.

Critical review of the case shows that the original explanation of the X-ray appearances was the correct one, and it is unfortunate that attempts to confirm the diagnosis by opaque meal and enema should have resulted in obscuring it. A possible explanation of the failure to demonstrate any part of either stomach or colon above the diaphragm by barium is that the small portions herniated may easily have returned to the abdomen under the weight of the opaque medium.

From a study of the series of plain X-ray films, it is clear that, while a constant volume of the spleen remained in the hernia throughout the whole period of observation, at times small portions of the stomach and colon severally occupied the sac as well (*Figs.* 441, 442).

It remains to be considered how the identity of the rounded opacity could have been established. The unusual translucency under the outer part of the left diaphragm suggests that the spleen was not in its normal position. This could have been demonstrated with certainty by inducing a pneumoperitoneum. Such a purely diagnostic procedure is, however, not without serious danger.[2]



FIGS. 441, 442.—Postero-anterior and left lateral views in erect position on an occasion when a part of the stomach occupied the hernial sac as well as the spleen. Sp., Spleen; G, Gas in cardiac end of stomach; DL, Left half of diaphragm.

A test which would probably have been useful in the present case is one recently described by Benhamou, Viallet, and Marchioni.[3] According to these workers, the physiological contraction of the spleen after the subcutaneous injection of adrenalin is such as to produce a clearly recognizable diminution in the splenic shadow as observed on serial X-ray films. Mention must also be made of lienography[4]—a method of rendering the spleen opaque to X rays by the intravenous injection of thorium. This method must still be regarded as being in the experimental stage, but with the evolution of less toxic contrast media, it may in the future be available in cases of this type.

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TUMOUR OF ABERRANT LATERAL THYROID.

By FRANK FORTY,
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THE following is the report of a case of tumour of an aberrant lateral thyroid.

CASE REPORT.

Miss A. C., aged 18, was admitted to the Birmingham General Hospital in March, 1932, under Mr. J. B. Leather, when she complained of a painless swelling on the right side of the neck, first noticed seven years previously. On two occasions the swelling had been aspirated, and artificial sunlight treatment had been given.

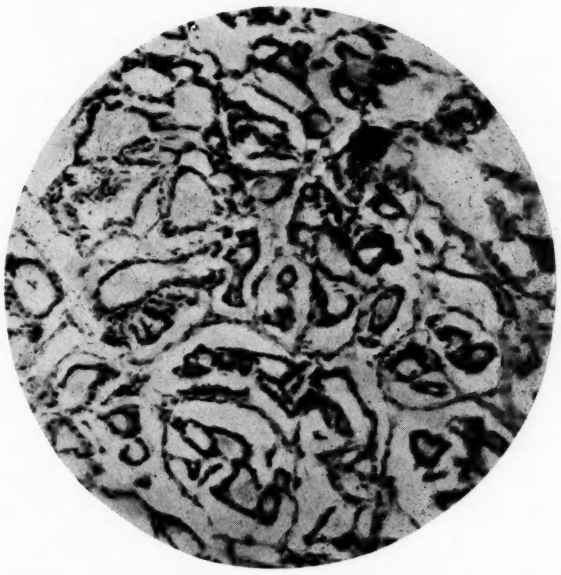

FIG. 443.—Acini lined by cubical epithelium, some containing colloid.

ON EXAMINATION.—The patient was a normally healthy girl. The swelling was the size of a hen's egg, situated deep to the right sternomastoid muscle on a line with the cricoid cartilage. It was smooth, firm in consistency, and slightly lobulated. It was not tender. It could be moved freely beneath the skin, and over the underlying structures. The thyroid gland was normal.

PRE-OPERATIVE DIAGNOSIS.—Tuberculous adenitis.

OPERATION.—The tumour was exposed from the posterior triangle of the neck, and was dissected out without difficulty, there being no dense adhesions to neighbouring structures, and no connection with the thyroid gland. The bluish-black colour of the tumour was very striking, and recalled the appearance of a melanotic growth. It contained numerous cystic spaces with smooth walls and containing an oily greenish-black fluid.

Microscopic Appearance.—Acini lined by a cuboidal epithelium are present, some containing colloid (*Fig.* 443). In places there is intra-acinar papilliferous formation (*Fig.* 444). Collections of small round cells are seen, situated chiefly beneath the capsule of the nodules (*Fig.* 445).

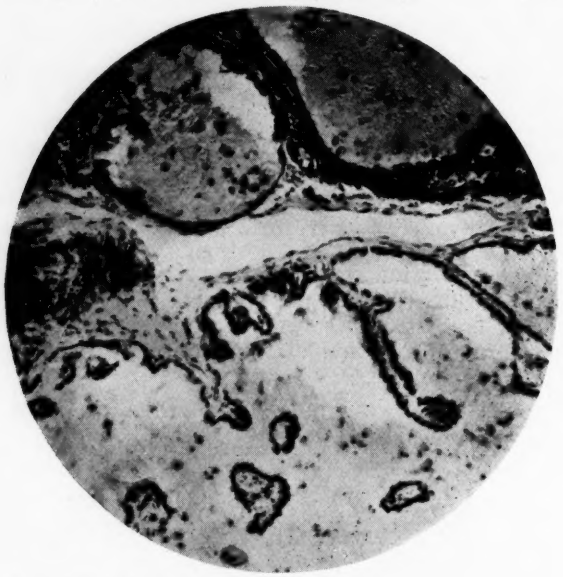

Fig. 444.—Intracystic papilliferous formation.

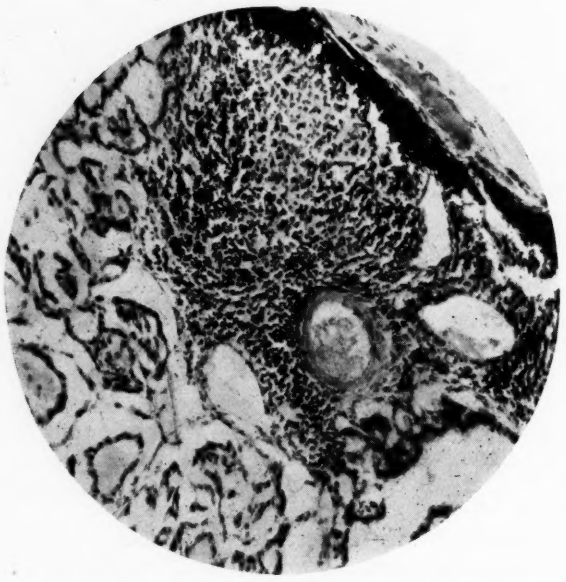

Fig. 445.—Collection of lymphocytes beneath the capsule of the tumour.

Post-operative Diagnosis.—A tumour of the neck arising in lateral aberrant thyroid tissue.

DISCUSSION.

Though of relatively rare occurrence, lateral aberrant thyroid tumours form a well-defined pathological group with a growing literature. Billings and Paul[1] in 1925 found 34 recorded cases, to which they added one of their own. In 1931 Cattell[2] reported 13 cases operated upon at the Lahey Clinic, and in the same year Dunhill[3] described 4 personal cases. Interest centres chiefly around: (1) The developmental nature of the nodules; (2) Their tendency to be the site of development of adenopapilliferous carcinoma; (3) The possible relationship of these tumours to cystic hygroma.

Developmental Nature.—It is well known that the greater part of the thyroid gland is developed from a median diverticulum of the floor of the primitive pharynx arising at the foramen cæcum. The situation of the thyroglossal cysts in the base of the tongue and in the middle line of the neck is sufficiently explained by the course followed by the thyroid bud as it grows caudalwards to occupy its normal position in the adult.

There is good evidence that thyroid tissue also develops from the fifth pharyngeal pouch, known as the ultimo-branchial body. This rudiment descends in the lateral region of the neck on either side, to fuse eventually with the lateral lobes of the thyroid gland, though the cells later appear to atrophy and to form little or no part of the adult gland. It is difficult to avoid the conclusion that tumours containing thyroid tissue found in the lateral regions of the neck have arisen in fœtal rests associated with an arrest of this process.

The researches of Williamson and Pearse[4] lead them to the conclusion that two distinct lymph systems drain the thyroid gland: (1) The 'lymphæ comites' of the veins, which drain to the lymphatic glands of the neck; and (2) The 'thyro-thymic' lymph system. In brief, they state that the latter is a closed lymphatic system, consisting of intra- and extra-thyroidal portions. The intra-thyroidal portion consists of lymph sinusoids draining into intra-lobular lymphatics which emerge from the gland at the hilum of each lobe. The extra-thyroidal portion consists of lymphatic channels, proceeding thence to their termination in thymic tissue. In the human embryo at a certain stage of development the thyro-thymic lymph system is a large cystic cavity pervading the structures of the neck, from the base of the skull to the mediastinum. Williamson and Pearse interpret the distribution of thyroid cancers anywhere in this region as arising within this thyro-thymic system, which they regard as one apparatus, developmentally and functionally.

Relationship to Papilliferous Adenocarcinoma.—Intracystic papilliferous change is almost universal in lateral aberrant thyroids, a feature in respect of which the case here reported conforms to type (*see Fig.* 444). Furthermore, most writers agree that there is a marked tendency for this to become malignant. In support of this view it is of interest to note that of the two cases reported by Dunhill[3] which he was able to follow up, one had involvement of the recurrent laryngeal nerve with paralysis of a vocal cord and ultimately died of malignant disease of the pelvis, while the other died of pressure on the trachea due to local recurrence after the removal of six nodules followed by deep X-ray therapy.

On the other hand, none of the cases reported from the Lahey Clinic showed any recurrence during periods ranging from ten months to five years following local removal and post-operative Roentgen therapy. Cattell[2] emphasizes the low grade of malignancy of these tumours, and states that a good prognosis can be given following the treatment indicated, even though microscopical examination reveals adenocarcinomatous changes.

Relationship to Cystic Hygroma.—Williamson and Pearse, in the communication quoted above, regard it as probable that the cystic hygromas are due to developmental abnormalities of the thyro-thymic lymph tract. They describe these as swellings formed by endothelial-lined cysts, peculiar in that their walls are constantly found to contain lymphocytes, and recalling in this respect the thymic lymph spaces of animals. This aggregation of lymphoid tissue immediately under the capsule is similarly a constant feature of lateral aberrant thyroids (*see Fig.* 445).

A further point of interest is that the cystic hygromas tend to manifest themselves, or to enlarge, shortly after birth and again at or about puberty. These are known to be periods of enhanced activity of the thyroid gland which probably induces an increased flow in the thyro-thymic lymph system.

Clinical Features.—A correct pre-operative diagnosis appears rarely to be made, the condition being usually mistaken for tuberculosis of the cervical glands, or for one or other of the commoner swellings of the neck. Suggestive features, however, are the appearance of the tumours at or about puberty, a long history without any considerable change in the condition, the situation of the tumour beneath the sternomastoid at any point from the base of the skull to the clavicle, the usually unilateral distribution, the absence of fibrosis around and fixity of the swelling, and the total absence of local or systemic symptoms, notably of any evidence of thyro-toxicosis. At operation the bluish-black colour of the tumour appears to be quite diagnostic.

I am indebted to Mr. J. B. Leather for permission to submit this case for publication, and to Professor J. Haswell Wilson, of the University of Birmingham, for help and advice with the histology.

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[2] Cattell, R. B., *Jour. Amer. Med. Assoc.*, 1931, Dec. 12.
[3] Dunhill, T. P., *Brit. Jour. Surg.*, 1931, xix, 83.
[4] Williamson, G. S., and Pearse, I. H., *Ibid.*, 1930, xvii, 529.

REVIEWS AND NOTICES OF BOOKS.

A System of Surgery. Edited by C. C. Choyce, C.M.G., C.B.E., B.Sc., M.D., F.R.C.S., Professor of Surgery in the University of London, etc. Pathological Editor, J. Martin Beattie, M.A., M.D., C.M., M.R.C.S., Professor of Bacteriology in the University of Liverpool, etc. Third edition. In three volumes. Medium 8vo. Vol. I, pp. 1112 + xxiv, with 33 colour and 67 half-tone plates, and 285 illustrations in the text. Vol. II, pp. 1111 + xvi, with 16 colour and 11 half-tone plates and 367 illustrations in the text. Vol. III, pp. 1107 + xvi, with 11 colour and 39 half-tone plates and 277 illustrations in the text. 1932. London: Cassell & Co. Ltd. £6 net the three volumes.

It is perhaps no exaggeration to say that this work represents the most important treatise on surgery extant in Great Britain at the present moment. This does not necessarily imply that it is the best; on this point readers must judge for themselves. But it does mean that the fifty-six surgeons who have collaborated with the editors include the great majority of the leaders of surgical thought and teaching in this country. The last edition was published in 1923, and it is rather remarkable that it has been found possible to keep the work within its present size. It actually contains about one hundred more pages, ten more plates, and a slightly increased number of text illustrations. In regard to the authors, it may be noted that these come from all over the country, Scotland and the provincial universities being well represented. Among the new authors may be mentioned the following: Birkett (radium), Dunhill (neck), Jefferson (nerves), Henry (animal parasites), Souttar (œsophagus), Walton (stomach and duodenum), Wilkie (tongue), and Julian Taylor (brain and spinal cord).

The first volume does not show any very marked changes from the earlier edition. It is concerned chiefly with the general surgical problems, such as bacteriology, inflammation, gangrene, tumours, infection, and the diseases of the breast. We are inclined to question whether the special section devoted to X-ray diagnosis is really worth separate treatment. We would suggest that the information contained in it would be better if divided up among the other contents of the book.

Pannett, writing on ulceration, commends very highly the use of elastoplast bandages in the treatment of chronic ulcers. Nitch gives a very good account of the varieties of pathology and treatment of gangrene, discussing both the vascular and neurological factors in its etiology. The section on gas gangrene gives the best account we know of the differentiation of this condition according to its extent and treatment. This is divided into four categories—namely, the local, group, segmental, and fulminating. Thrombo-angiitis obliterans is discussed in detail, and a very fair account given of the scope of ganglionectomy in its treatment. The only omission we have been able to find in this extraordinarily good section is that of puerperal gangrene.

The tannic acid method of treating burns is carefully described and well illustrated by Gardham, and it is clear that in the opinion of the majority of English surgeons this method has superseded all others in the treatment of burns which do not destroy the whole depth of the skin. There is also a full account of burns by radium and X rays.

In the last edition we were told by Martin that passive immunization as a treatment for septicæmia was still on trial. This phrase still remains ten years later. The use of the direct injection of antiseptics is dismissed in two lines and there is no mention of perchloride or mercurochrome. The section on tumours, originally written by Raymond Johnson and now revised by Lawrence, does not show so many alterations or additions as we should have anticipated. We think that the description of myeloma as a benign growth, showing no tendency to cause deposits in lymph-glands or other metastases, is probably too dogmatic, as

a considerable proportion of cases followed up in the *American Sarcoma Register* do show metastatic growths. Eloquent testimony is afforded of the very little real progress that has been made in the elucidation of cancer problems by the fact that one page suffices to summarize the work on artificially produced tumours.

The sarcomata are still classified as endosteal and periosteal, whilst the osteogenetic type is not mentioned. This may be only a question of names, but more serious is the very scanty reference to Ewing's sarcoma. It is not referred to in the section on tumours, and in a later article in Volume III it is only given seven lines, and its remarkable resemblance to osteomyelitis and its radiosensitivity are not mentioned.

Birkett's article on radium is disappointingly short. He gives full prominence to the variation in radiosensitivity of the different cell types of epithelial growths. The problems of the bomb are not discussed.

The article by Harrison on syphilis is quite a classic. We find with regret that the problem of treatment seems to have become longer and more difficult than ever, as bismuth is now added to the mercury, iodide, and arsenic as a part of the routine method. Swift-Joly deals with gonorrhœa, and there is a good new plate showing the typical appearances found in urethroscopy.

There are no essential changes in Handley's article on the breast. In the treatment of cancer, however, he advocates the use of the diathermy knife for excision, and he refers briefly to the possibility of treating even early cases by radium, though he advises that the older and tried methods of excision should not be abandoned.

The second volume is chiefly concerned with diseases of the abdomen, together with those of the face, mouth, and gullet. In general terms it is unnecessary to criticize or comment upon this part of the work in any detail. It represents the accepted teaching of British surgeons, and this has not undergone much change since the appearance of the last edition.

Nitch, in describing the treatment of cleft palate, has included the operative methods of Veau and Gillies. We should have thought the time had come in which to relegate the methods of Brophy and Arbuthnot Lane to an unimportant place. The chapter on the œsophagus, originally written by Rigby, is brought up to date by Souttar, who gives some excellent illustrations of the endoscopic appearance of different types of cancer.

The chapter on diseases of the tongue, revised by Wilkie, gives due prominence to the important part played by radium in the treatment of cancer, whilst the more mutilating operations are omitted. Walton has revised the article by Sherren on the stomach and duodenum without making any striking changes in its general tenor. Maybury and Williams give a good account of appendicitis, with a reasoned statement advocating operative treatment in all but the late cases. We welcome this especially as coming from St. Thomas's Hospital, where the dangerous doctrine of doubt and delay was so much encouraged. Such a statement of common-sense view is particularly welcome at present in order to counteract the deplorable effects of certain recent utterances advocating a policy of *laissez faire*.

Clogg describes diseases of the rectum and anus. In the treatment of cancer of the rectum he only gives two radical methods—namely, perineal excision and abdomino-perineal ablation. Methods which preserve the anal sphincter are not discussed.

The article by Russell Howard on the prostate and male genital organs is full and clear. We do not think it gives quite a fair account of the possibilities and results of orchidopexy.

The section on the female genital organs is by Bonney, who still advocates the radical removal of the cervix for carcinoma rather than the use of radium. The dscription of endometrioma is very short and incomplete, giving no idea of the clinical picture of this disease when it spreads to the intestine.

We think it rather unfortunate that the article on the heart and blood-vessels by Rock Carling has had to be placed so far away from that which describes gangrene. In neither of these articles does the subject of embolectomy receive the consideration that it merits.

Volume III shows two important changes of authorship. The section on the

neck, including the thyroid and parathyroid, is written by Dunhill, and that on the nerves by Geoffrey Jefferson.

Dunhill's article on goitre is remarkable for its clear exposition of the subject and its simple classification. All conditions of hyperthyroidism are grouped together under the term 'toxic goitre'. Exophthalmic goitre is the primary form. The early secondary form presents a tumour of the neck before the symptoms. The late secondary form includes toxic adenoma, and in this the cardiac symptoms predominate.

Jefferson deals with the peripheral nervous system. He admits the experimental evidence of successful nerve-grafting, but considers that at present there is no clinical application for this method. Surgery of the sympathetic nervous system is rather briefly summarized, and further elaboration in the description and illustration of operative methods would be acceptable. The chapters dealing with the brain and spinal cord are still by Trotter, but with the assistance of Julian Taylor. For the neurological aspect of this subject we have nothing but admiration, but it is unfortunate that the surgery of the vertebral column is so very sketchy. The treatment of certain types of fractured spine from a practical point of view is more important than the theory of the nature of concussion. The fixation of fractures of the spine which are uncomplicated by spinal-cord injury require detailed and dogmatic description.

Diseases of the bone are dealt with by Choyce, who has adopted the comparatively conservative methods of Starr in the treatment of osteomyelitis. The value of Winnett Orr's packing with vaseline and fixing with plaster is recognized and recommended. In a later article by the same author on diseases of the joints we think that some mention might have been made of osteochondritis dissecans as one of the varieties of internal derangement of the knee.

The article on fractures is by Hey Groves, who in addition to the material in the last edition gives an illustrated account of the treatment of a fractured patella by means of a strip of fascia lata. We think that this article would have been more complete if reference had been made to the skin-tight plaster methods of Böhler, the advantages of operating under local anæsthesia, and the forcible correction of fractures of the os calcis.

A Synopsis of Surgical Anatomy. By Alexander Lee McGregor, M.Ch. (Edin.), F.R.C.S. (Eng.), Lecturer on Surgical Anatomy, University of Witwatersrand, etc.; with a Foreword by Sir Harold J. Stiles, K.B.E., F.R.C.S. (Edin.). Crown 8vo. Pp. 609 + xvi, with 606 illustrations. 1932. Bristol: John Wright & Sons Ltd. 17s. 6d. net.

It does not require a very long perusal of this book to make one realize that it is something fresh and unusual. One is accustomed to think of anatomy and even surgical anatomy as being something terribly dry and stereotyped. Certainly this book is neither the one nor the other. In the variety of its subject-matter and the cleverness of the illustrations it intrigues us, and we feel quite the excitement of turning over the pages of the latest thriller to see what the next chapter is going to be. Six hundred closely printed pages and over six hundred illustrations indicate something of the length of the book, but give no hint as to its features of variety and novelty. A Foreward by Sir Harold Stiles and an Introduction by Professor Dart indicate the high ideals aimed at in the book.

The two happy features of the work are the way in which the author has brought in all manner of surgical subjects and talked about them from an anatomical point of view, and also the clever way in which the artist has given diagrammatic representation of the matters described in the text.

Some of the subjects discussed are as follows, and these will give an idea of the scope of the work: the parathyroid and fibrocystic disease, the variations of the bile-ducts and cystic artery, the anatomy of the child, the sympathetic nervous system, the diaphragms of the body, the accessory bones, errors of development, diverticula, bodily habitus, the pathology of bone in terms of anatomy, the anatomical bases of clinical tests, backache, and the anatomy of surgical approach.

We have great pleasure in congratulating the author, the artist, and the publishers on the production of a very useful and remarkable book.

A Short Practice of Surgery. By HAMILTON BAILEY, F.R.C.S., Surgeon, Royal Northern Hospital, etc.; and R. J. MCNEILL LOVE, M.S. (Lond.), F.R.C.S., Surgeon, Royal Northern and Metropolitan Hospitals, etc. Two volumes. Demy 8vo. Vol. I, pp. 536 + viii, with 269 illustrations. Vol. II, pp. 475 + viii, with 352 illustrations. 1932. London: H. K. Lewis & Co. Ltd. 20s. net each.

IN Mr. Hamilton Bailey's former books, one always found concise statements, a wealth of excellent illustrations, clear sketchy diagrams, and a mass of practical information of the greatest use to students reading for examinations, and to practitioners anxious to learn quickly a precise method to employ in any particular condition. In this, his latest work, in which he has collaborated with Mr. McNeill Love, one notices the same clear-cut style and the same brilliant illustrations. The *Short Practice of Surgery* will undoubtedly be a popular work with students, but it is something more than a mere text-book. The authors have successfully eliminated all obsolete methods and introduced many modern procedures. It is an easy book to read, and has the further advantage of differential type, the smaller being used for rare and unimportant matter. For examination purposes we believe the book will be widely read. The danger for examinees lies in slavishly copying its pithy sentences, its diagrams, and its lists. A student would be well advised to supplement its reading with a more philosophical and less dogmatic text-book.

Practical Anatomy by Six Teachers. Edited by E. P. STIBBE, F.R.C.S., Senior Demonstrator in Anatomy, London Hospital Medical School. Demy 8vo. Pp. 719 + xii, with 337 illustrations. 1932. London: Edward Arnold & Co. 30s. net.

THE general style of this volume, which is founded on a similar work by Professors Parsons and Wright, is peculiar; it cannot be regarded purely as a practical guide for the dissecting-room, and it is scarcely full enough to be termed a manual of anatomy. In a sense it combines the qualities of both, and, compared with the ordinary dissecting-room manual, is much easier to read and understand, as the description of structures is more consecutive and coherent than is usual in books which describe only what is seen at a given period of the dissection. As a general principle, anatomy is treated in this volume as seen during a dissection, and in its arrangement and apportionment of space to the different parts of the body, it follows on accepted lines.

As is natural for a book that is the combined production of six expert anatomists, its use will be in the dissecting-room or as a help for pre-clinical anatomy examinations rather than as an aid to a surgeon interested in anatomy from an operative point of view. In this respect we feel that the authors have missed an opportunity of writing a book on practical anatomy in which the clinical importance of medicine and surgery should be constantly in evidence. Wishing to discover whether the authors had this point of view, we looked up the description of the abdominal sympathetic and of the lymphatic drainage of the large intestine. The authors must be aware of the importance in medicine and surgery of the sympathetic nervous system, and no doubt realize that if medical students are to understand the application of surgery to it, they must have an accurate knowledge of its anatomy. The description of the sympathetic system is very sketchy, and the lymphatic drainage of the colon, as of other organs, is scarcely touched upon. Admittedly this volume deals only with those things which can be seen in the dissecting-room, but the average medical student only learns anatomy with a view to the study of medicine and surgery; and it is to be hoped that in the next edition some space may be allotted to these subjects, space which may be taken from the fifty pages given to the topographical anatomy of the brain.

It is significant that this volume is written in what is now called the old nomenclature, though in places the Basle terminology is introduced in brackets. A volume written by different authors in six chapters cannot be uniform in view-point, but so far as is possible under the circumstances it is evident that the object of each author has been to provide a strictly practical volume. The book seems to be singularly free from inaccuracies and is well printed and illustrated.

La Pratique chirurgicale illustrée. By VICTOR PAUCHET. Fasc. XVIII. Super royal 8vo. Pp. 264 + vi, with 189 illustrations. 1932. Paris: G. Doin et Cie. Fr. 65.

THE eighteenth volume of Pauchet's illustrated surgery maintains the high standard met with in previous volumes, and commences with an article by A. Tierny on pharyngeal abscess. Dr. Tierny recommends ligature of the external carotid artery and internal jugular vein before opening the abscess to avoid the risks of secondary hæmorrhage, and advises leaving the external wound unsutured.

Dr. de Butler D'Ormond writes briefly on rupture of the diaphragm and diaphragmatic hernia, and advocates the thoracic approach. Dr. Robert Soupault describes a method of dealing with non-malignant stricture of the lower end of the œsophagus. He exposes the cardiac end of the œsophagus, having first turned back the left lobe of the liver, after division of the left lateral ligament (following Grey Turner). After enlarging the opening in the diaphragm he pulls down the œsophagus and opens it at the lower end, dividing the muscular coat only, which he slits up longitudinally for from 6 to 8 cm. This writer also describes an operation for excision of a dislocated semilunar bone, for which he employs local anæsthesia to the brachical plexus.

Pauchet writes briefly on suppurating gall-bladder and intestinal obstruction from impacted gall-stone, and also describes his method of dealing with jejunal ulcer by a major gastrectomy with resection anastomosis of the involved jejunal loop followed by a new gastrojejunostomy in Y. He advocates partial colectomy for volvulus of the sigmoid, performing a lateral anastomosis outside the abdomen and using a Paul's tube for temporary drainage.

Dr. Dartigues writes on the Voronoff operation. He employs an inguinal incision, pushes the testicles out through the wound, and sutures the graft to the parietal layer of the tunica vaginalis, which is scarified after rubbing the surface of the tunica with a swab until the vessels are exposed.

Skin-grafting for repair of ruptured perineum by Leon Imbert, nerve-grafting for injury to the musculospiral nerve, and a plastic operation for lengthening of the biceps by George Pascalis call for no special comment.

Dr. Masmonteil writes on operative repair of a T-shaped fracture of the lower end of the humerus. The apparatus he employs for traction is most ingenious. He divides the olecranon, drives a long screw through the condyles transversely, and employs a Y-shaped plate to secure the two condylar fragments to the shaft. The employment of a long screw to join up the olecranon seems unnecessary. He also describes a method of screwing the shaft to the neck of the femur for fracture, and gives an account of Hey Groves's operation for repair of crucial ligaments.

Dr. Marc Iselin has written an interesting article dealing with repair of tendons in the hand. When a tendon is divided in the finger he makes a transverse incision in the palm and draws the tendon out of its sheath (and does the same with the distal end through an incision beside the terminal phalanx). He then employs the figure-of-eight 'suture en lacet' of Cunéo for each end and re-introduces the proximal portion of the tendon into the sheath, using a special probe inserted from the distal end. He believes in secondary suture of the main wound. This article is very instructive.

Dr. George Pascalis employs double lateral suture with bronze wire for fracture of the patella, and describes a method of circular subcutaneous suture for a vertical fracture.

Recent Advances in Anæsthesia and Analgesia. By C. LANGTON HEWER, M.B., B.S. (Lond.), Anæsthetist and Demonstrator in Anæsthetics, St. Bartholomew's Hospital, etc. Large post 8vo. Pp. 187 + viii, with 64 illustrations. 1932. London: J. & A. Churchill. 12s. 6d. net.

As the author rightly reminds us in his preface, this is not a text-book or a volume from which elementary instruction may be gleaned, but is a genuine attempt to record the modern trend, methods, and scope of anæsthesia and analgesia. In this endeavour the author has certainly succeeded, and if some of his descriptions of new methods do err on the side of brevity, he has, at any rate, appended a most complete

and useful list of references at the end of each chapter. In this way the key of a very considerable storehouse of knowledge is presented to the reader.

The chapter on resuscitation during anæsthesia is both valuable and interesting; all the most modern views and methods are described, and attention is drawn to the all-important time factor in the initiation of treatment for primary cardiac failure. Chapter III, on pre-medication, synergism, and basal narcotics, though well written and easily understood, is all too short and makes the reader wish for more. However, no fewer than thirty-four clearly marked references are appended to this short chapter, and will enable the reader to seek any further information he may require. A valuable warning is given at the end of the section of Chapter III headed 'Pernocton': "In conclusion it should be added that if any basal narcotic has been used in a combination anæsthesia, it is essential that the anæsthetist should impress upon all those responsible that no further narcotic of any description whatever should be given after operation until the patient is completely conscious and complaining of pain or is very restless. Neglect of this precaution has led to several fatalities."

Three chapters are devoted to analgesia, and are headed (1) Local analgesia; (2) Recent advances in the technique of local analgesia; and (3) The present position of spinal analgesia. The author is very definite in his views about the desirability of employing some general agent to abolish consciousness in addition to the use of analgesia. "A visit to a Continental clinic where no general anæsthesia is used, leaves no doubt in the mind of the visitor of the reality of 'psychic shock', although the actual technique may be of a very high order of excellence. The mentality of the patient must always be considered before deciding upon a local method. It will be found that patients can be roughly divided into two groups. On being questioned, one will say, 'I don't mind what you do to me so long as I am asleep and know nothing'. A typical example of the second type will make some remark as, 'I don't mind the operation but I do dread the anæsthetic'. The first group undoubtedly predominates, at any rate in this country, and to attempt a simple local analgesia on them is nothing short of cruelty. A basal narcotic or nitrous oxide-oxygen inhalation can usually be given as well without increasing the risk." The vast majority of British anæsthetists will agree with the author in his views upon this controversial subject.

The book is clearly printed and the illustrations are both well reproduced and really up to date. The author deserves the thanks of all interested in anæsthesia for this praiseworthy compilation of post-war advances in anæsthesia and analgesia.

Electrosurgery. By HOWARD A. KELLY, M.D., LL.D., F.A.C.S., and GRANT E. WARD, M.D., F.A.C.S. (Baltimore). Large 8vo. Pp. 305 + xxii, with 382 illustrations. 1932. Philadelphia and London: W. B. Saunders Company. 35s. net.

IN recent times high-frequency electric currents have been increasingly employed in surgery, especially in that of malignant disease, whether it be to replace the scalpel by 'electro-section', or the ligature by 'electro-coagulation', or to ensure the actual destruction of the malignant growth itself by coagulation or 'fulguration'. A study of the history of electro-surgery discloses the very large share that American investigators have taken in its progress, and the book now under review, written by two famous American surgeons, constitutes an admirable summary of the present status of this aspect of electro-therapeutics.

The physics of high-frequency currents takes first consideration, and stress is laid upon the essential differences between the 'damped' and 'undamped' wave-currents, whilst it is rightly recognized that the present tendency is towards the supersession of the 'spark-gap' apparatus by that utilizing the vacuum tube or thermionic valve. The histological changes and the physiological effects upon the tissues in general of the various types of current are fully detailed and are well illustrated by micro-photographs. Reference is next made to the general principles of electro-surgical treatment and to special points of detail in technique. Each region of the body is successively considered in relation to the possibilities and limitations

of electro-surgery, and these chapters, thoroughly up-to-date, are calculated to strike wonder in the minds of those who have not kept pace with recent electro-surgical developments. Especially interesting and instructive is the section dealing with urology, wherein is a full and well-illustrated account of the more recent methods of trans-urethral resection of contractions and 'bars' at the vesical neck and of the obstructing portions of the gland in benign prostatic hypertrophy. The subject of bladder tumours is dealt with in a most thorough manner by Hugh H. Young, who is a well-known advocate of the combination of electro-coagulation and the application of radium for such conditions, and who claims that with this dual method the majority of papillary tumours, even the malignant, can be successfully destroyed.

This book can be strongly recommended to all progressive surgeons, and its careful perusal will serve to refute the suggestion, not infrequently made elsewhere, that the craft of surgery has now reached its limitations.

Minor Surgery of the Urinary Tract. By HERMON C. BUMPUS, junr., Ph.B., M.S. in Urology, F.A.C.S., Section on Urology, the Mayo Clinic. Medium 8vo. Pp. 124, with 57 illustrations. 1932. Philadelphia and London: W. B. Saunders Company. 15s. net.

THE title of this work is rather misleading, since comparatively few of the procedures described therein will be regarded, at any rate in this country, as 'minor' surgery. It treats mainly of the modern applications of endoscopic surgery—a line of practice in which the author is universally acknowledged a leading expert.

The progressive development of high-frequency endoscopic treatment is traced from its first employment by Beer in the destruction of vesical papillomata to its recent use in the trans-urethral removal of prostatic obstructions. Here it is pointed out that prostatic obstruction is caused not by the entire gland, but by only a small portion at a particular site in the urethra: it seems illogical, therefore, to perform such a major operation as a complete prostatectomy when all that is essential is the removal of the small obstructing mass from the readily accessible urethra. Out of 231 cases of prostatic hypertrophy treated surgically at the Mayo Clinic in 1931, trans-urethral resection was carried out in 82 (42 per cent). The author considers that this proportion will steadily increase, though he does not believe that prostatectomy will ever be completely displaced. The 'Bumpus' method of trans-urethral resection is described in detail.

Broders' grading of vesical carcinomata is commended, and the importance of a preliminary biopsy to ascertain the degree of malignancy is fully stressed. Contrary to what has been stated elsewhere, this procedure has not been shown to have hastened metastasis during the seventeen years of its practice at the Mayo Clinic. The various manipulative methods for the extraction of calculi from the lower ureter are well described, and they are considered applicable nowadays to the majority of such cases.

The work is well illustrated and is fully up-to-date, as evidenced by the careful description of the uses of the ketogenic diet in infections of the urinary tract.

Tuberculose osseuse et ostéo-articulaire. By ETIENNE SORREL, Chirurgien de l'Hôpital Trousseau, and Mme. SORREL-DEJERINE, Ancien Interne des Hôpitaux de Paris. Royal 4to. Pp. 514, with 640 illustrations. 1932. Paris: Masson et Cie. Fr. 350.

WE have already had occasion to give an appreciative notice of former volumes in this series dealing with the radiographic appearances of the normal and pathological skeleton. The present work is again almost beyond praise, both for the beauty and wealth of illustrations and the careful detail used in discussing diagnosis and treatment. It really forms a complete treatise dealing with the subject of tuberculous disease of the bones and joints, such as will be most useful to every

orthopædist or general practitioner. The etiology and pathogenesis of the disease are given only in sufficient outline to enable the reader to understand the evolution of the morbid process, but the pathological anatomy is described and illustrated in all stages in minute and comprehensive detail. The sections on diagnosis rely very largely upon showing radiograms of other lesions which may be mistaken for tuberculosis. The treatment which is outlined is sufficient for practical purposes; general principles of treatment are given first, followed by conservative orthopædic methods, and when necessary by methods of open operation. There are four chapters: the first deals with tuberculous disease of the bones, the second with that of the joints of the upper limb, the third with the lower limb, and the fourth with the vertebral column.

The uniform excellence of the text and the beauty of the figures do not allow of much critical comment. The description of tuberculous periostitis or spina ventosa is particularly good and complete, whilst the figures of syphilitic periostitis and osteomyelitis given for comparison are very instructive. In the sections dealing with tuberculous joints, we may perhaps take exception to the prominence given to methods of treatment which involve open excision of certain joints, e.g., the shoulder, the hip, and the tarsus. Possibly in this country we have gone too far in practically abandoning these operations, but we hesitate to accept the suggestion that excision of the head of the femur or of the astragalus can often be indicated, or that such operation will often give a lasting good functional result. In excision of the knee we do not like the use made of metallic staples and wire for fixation methods, holding them to be unnecessary and sometimes harmful. In the section on tuberculous spines, the figures of the diseased or damaged spinal cord are very complete and of high artistic merit. We think, however, that in this section, greater space might be given to illustrating the very early lesions, and less space to the late gross deformities, because the latter give no difficulty in diagnosis and allow of very little in the way of curative treatment. It is stated that sacro-iliac disease is very rare in a primary form, and therefore it is not illustrated.

As a standard book of reference this work will quickly take a recognized and leading place.

Thrombose: ihre Grundlagen und ihre Bedeutung. By Prof. Dr. A. DIETRICH (Tübingen). Pathologie und Klinik in Einzeldarstellungen. Vol. IV. Large 8vo. Pp. 102, with 26 illustrations. 1932. Berlin and Vienna: Julius Springer. Paper covers, RM. 8.20; bound, RM. 10.

THIS small monograph forms one of a series dealing with special problems of clinical pathology. It consists in a careful account of all the known facts concerning the incidence and accompaniments of thrombosis and embolism, with a number of well chosen illustrations showing the changes in the blood-clot and the vascular wall which are associated with these phenomena.

Clotting of the blood has been an event which has always fascinated the physiological and surgical research worker. Hunter and Lister each in his day tried to explain the mystery. In modern times the resources of biochemistry still continue to reveal new facts, but leave us still in doubt as to their meaning. Such recondite ideas as the electrical charge of the blood-platelets and the colloidal composition of the blood-plasma have been investigated, but, like the older notions of mechanical hindrances to the circulation and damage to the vessel wall, they do not provide the solution to the problem.

In regard to practical statistics, 911 cases are analysed. The proportion of cases of thrombosis which led to embolism was 53·1 per cent, and the fatal caess were 35·3. Only if two-thirds or more of the pulmonary circulation is blocked, does embolism cause immediate death. Only about one-half of the cases of pulmonary embolus gave a typical clinical picture.

The monograph concludes by a lengthy list of references to the literature, which is, however, taken solely from German sources.

Intracranial Suppuration. By E. Miles Atkinson, M.B., B.S.(Lond.), F.R.C.S., Surgeon-in-Charge of the Ear and Throat Department, Royal United Hospital, Bath. Modern Treatment Series. Crown 8vo. Pp. 127. 1932. London: Jonathan Cape Ltd. 5s. net.

This little book presents in concise and reasonable form the essentials of the present day opinions regarding the pathology, symptomatology, and treatment of intracranial suppuration. It should prove of great use not only to the general practitioner, for whom it is primarily written, but also to otologists, whose acquaintance with the surgery of the brain is often restricted and vague. As a summary for the use of students preparing for the higher examinations it should prove most valuable.

When the author's views differ from those held by other surgeons—as they do here and there—good reasons are given for his opinions, a fact which adds to the interest and value of the book.

The only obvious point of criticism is the omission of any reference to the shelling out whole of the more chronic abscesses, a method of treatment which can now and then be carried out quite easily, and the results of which are far better than can be attained by any form of drainage.

Erdmann's Clinics. Excerpts selected from the Clinics of John F. Erdmann, M.D., F.A.C.S., Professor of Surgery in Colombia University. Edited by J. William Hinton, M.D., F.A.C.S., Associate Professor of Surgery, New York Postgraduate Medical School. Large 8vo. Pp. 315 + vi, with 39 illustrations. 1932. Philadelphia and London: W. B. Saunders Company. 22s. 6d. net.

These abstracts from the clinics of J. F. Erdmann cover the whole field of abdominal surgery, including gynæcology and urology, as well as that of the breast, larynx, and some other regions. Together they give a clear and concise idea of Erdmann's teaching and his operative methods, and they abound in useful hints and practical suggestions which invariably bear the imprint of a most extensive personal clinical experience. Stress is laid upon the careful pre- and post-operative care of the patient, and Erdmann allows his patients up on the fifth or sixth day after an abdominal section without drainage. It is noteworthy that the post-operative radiation of 'radical' breast cases is no longer employed in the clinic unless specially requested by the patient, her physicians, or her friends, since it is considered to have increased the proportion of skin-recurrences and chest complications.

These lectures will be widely appreciated, especially by those who have visited Erdmann's clinic and have admired alike the great rapidity and the extreme thoroughness of his practical work.

The Melbourne Hospital Clinical Reports. Edited by S. O. Cowen, Julian Smith, jun., et al. Vol. III. No. 1, June, 1932. Crown 4to. Pp. 58, illustrated. 1932. Melbourne: W. Ramsay (Surgical) Pty. Ltd. Annual subscription, 10s. 6d.; single numbers, 6s.

This number opens by a sympathetic obituary notice by Sir Richard Stawell, K.B.E., of Dr. John Williams, who served the Melbourne Hospital from 1879 to 1904 and filled a prominent place in the early days of medical development in Melbourne. Dr. B. T. Zwar contributes an important paper on 200 cases of disease of the gall-bladder and biliary passages. He insists on the value of cholecystectomy and favours incision of the common duct when there is any doubt as to the possibility of stones being present in it. The report of a pathological demonstration by Dr. R. J. Wright-Smith on meningiomata contains some beautiful illustrations. Dr. A. E. Coates reports a case of ligature of the innominate artery for an aneurysm of the right subclavian artery, which he regards as traumatic in origin. He also is of opinion that the collateral circulation which developed in his case did not follow the classical course described in text-books. The volume concludes with statistics for the year 1930–1 which indicate a marked difference in the incidence of disease in Australia as compared with this country, and show also that surgical opinion in Victoria in many details does not conform to the operative practice in London.

St. Bartholomew's Hospital Reports. Edited by Sir THOMAS HORDER, Bart., K.C.V.O., RONALD G. CANTI, WILFRED SHAW, CHARLES F. HARRIS, J. PATERSON ROSS, R. C. ELMSLIE, W. GIRLING BALL, and GEOFFREY EVANS. Vol. LXV. Large 8vo. Pp. 1–317, with Index of Vols. XLI–XLV. Illustrated. 1932. London: John Murray. 21s. net.

THE obituary notice of Sir Frederick William Andrewes recalls his charming personality and reminds those who worked within the London area during the war of the valuable work that he did in the treatment of tetanus. Mr. Douglas Harmer's Semon Lecture on the relative value of radiotherapy in the treatment of cancer of the upper air-passages—regarded in this country as a classical authority on this question—is reprinted with admirable illustrations. Mr. J. Paterson Ross contributes a thoughtful paper on causalgia, for which he advocates sympathectomy; he attributes the success of this treatment to the fact that dilatation of the small vessels of the limbs disappears after operation. Mr. R. W. Raven discusses the subject of secondary malignant disease of bone and emphasizes the incompleteness of our knowledge of this subject.

Die Lebensvorgänge im normalen Knorpel und seine Wucherung bei Akromegalie. By Professor Dr. J. ERDHEIM, A. O. Professor in the University of Vienna. Pp. 160, with 31 illustrations. 1931. Berlin and Vienna. Julius Springer.

THIS book, the third of a series of special monographs on pathology and medicine, is devoted to a study of the vital processes in costal cartilage and its proliferation in acromegaly, founded on careful histological examination of the skeletons of two old women, one acromegalic and the other with a normal pituitary body. A minute description of the development and life-history of cartilage in the normal and in the acromegalic patient is given and illustrated clearly. The resumption of enchondral ossification of an abnormal type under the stimulus of hyperpituitarism has been thoroughly studied in the costal cartilages, and the increase in length of the ribs attributed to the resulting proliferation of cartilage; this proliferation factor is also held responsible for the arthritic changes in acromegaly.

The author emphasizes throughout the work the harmonious relationship between the anterior lobe of the pituitary gland and body growth, and makes some tentative suggestions for the use of anterior lobe extract as a therapeutic measure.

Chirurgische Krankengymnastik. By Dr. KARL GEBHARDT, Assistant at the Munich University Surgical Clinic, and in charge of the Sports Department. Pp. 42, with 37 illustrations. 1931. Leipzig: Johann Ambrosius Barth.

THIS monograph is intended to be a short introduction to medical gymnastics for doctors and masseurs, and presents a thoughtful account of some years' special experience in this work. Emphasis is laid on the importance of accurately deciding which body tissue is injured so that treatment may be suitable; a good account of the properties of the various tissues and the methods for the proper stimulation of each is given. Schemes of exercises and the indications for their use are explained and well illustrated.

BOOK NOTICES.

[The Editorial Committee acknowledge with thanks the receipt of the following volumes. A selection will be made from these for review, precedence being given to new books and to those having the greatest interest for our readers.]

Radiologic Maxims. By HAROLD SWANBERG, B.Sc., M.D., F.A.C.P., Editor of *The Radiological Review*. With a Foreword by HENRY SCHMITZ, A.M., M.D., LL.D., F.A.C.P., F.A.C.S. Large 8vo. Pp. 127. 1932. Quincy, Ill.: Radiological Review Publishing Co. $1.50 net.

The 1932 Year Book of Radiology. Edited by CHARLES A. WATERS, M.D., Associate in Roentgenology, Johns Hopkins University, etc. (Diagnosis), and IRA I. KAPLAN, B.Sc., M.D., Director, Division of Cancer, Department of Hospitals, New York, etc. (Therapeutics). Medium 8vo. Pp. 750, with 498 illustrations. 1932. Chicago: The Year Book Publishers, Inc. $6.00.

Cinquante Techniques chirurgicales de Henry-Delagenière. Collected and edited by YVES DELAGENIÈRE. Large 8vo. Pp. 315, with 63 illustrations. 1933. Paris: Masson et Cie. Fr. 50.

Le Genou. Anatomie chirurgicale et radiographique: Chirurgie opératoire. By ANTOINE BASSET, Professeur agrégé à la Faculté de Paris; Chirurgien de l'Hôpital Beaujon. Royal 8vo. Pp. 189, with 120 illustrations. 1932. Paris: Masson et Cie. Fr. 45.

Final Report of the Commission on Medical Education. Medium 8vo. Pp. 560. 1932. New York: Office of the Director of Study, 630 West 168th Street.

A Short History of Surgery. By SIR D'ARCY POWER, K.B.E., F.R.C.S., Hon. Librarian of the Royal College of Surgeons of England. Crown 8vo. 1933. London: John Bale, Sons & Danielsson, Ltd. 3s. 6d. net.

Trattato di Patologia chirurgica generale e speciale. By Prof. OTTORINO UFFREDUZZI (Turin). Large 8vo. Vol. I. Pp. 724 + vi, with 345 illustrations and 8 coloured plates. 1933. Turin: Unione Tipografico-editrice Torinese.

Chirurgische Tuberkulose. By Dr. Med. M. FLESCH-THEBESIUS (Frankfurt a. M.). Medizinische Praxis, Vol. XV. Large 8vo. Pp. 194 + xiv, with 58 illustrations. 1933. Dresden and Leipzig: Theodor Steinkopff. Paper covers, RM. 15; bound, RM. 16.20.

The Principles of Treatment of Muscles and Joints by Graduated Muscular Contractions. By MORTON SMART, C.V.O., D.S.O., M.D., Ch.B. Edin., Late Medical Officer in Charge of the Electrotherapeutic Department, Hospital for Sick Children. Great Ormond Street. Large 8vo. Pp. 217 + xvi. 1933. London: Humphrey Milford. 15s. net.

Tactique opératoire du Pancréas et de la Rate. By J. OKINCZYC and L. AUROUSSEAU (Paris). Royal 8vo. Pp. 267 + viii, with 106 illustrations. 1933. Paris: G. Doin et Cie. Fr. 75.

Guy's Hospital Reports. Edited by ARTHUR F. HURST, M.D. Vol. LXXXIII (Vol. XIII, Fourth Series), No. 1, January, 1933. Royal 8vo, pp. 1–128. Illustrated. London: Published at Guy's Hospital. Obtainable also from Headley Brothers, 109, Kingsway, W C.2. Annual subscription, 42s. net; single numbers, 12s. 6d. net.

De l'Exclusion haute de l'Estomac. By BERNARD-OLIVIER GUIHENEUC. Royal 8vo. Pp. 78. 1932. Paris: Imprimerie Lahure.

Chirurgie de la Main. Plaies, Infections, Chirurgie réparative. By MARC ISELIN. Ancien Interne des Hôpitaux. Royal 8vo. Pp. 340 + xii, with 111 illustrations, 1933. Paris: Masson et Cie. Fr. 55.

Internal Derangements of the Knee-joint: Their Pathology and Treatment by Modern Methods. By A. G. TIMBRELL FISHER, *M.C.*, M.B., Ch.B., F.R.C.S., Late Assistant, Surgical Unit, University College Hospital. Second edition. Demy 8vo. Pp. 205 + xiv, with 120 illustrations. 1933. London: H. K. Lewis & Co. Ltd. 15s. net.

Poliomyelitis. A Survey made possible by a grant from the International Committee for the Study of Infantile Paralysis organized by Jeremiah Milbank. Large 8vo. Pp. 562 + xxii, with 25 plates. 1932. Baltimore: The Williams & Wilkins Company. (London: Baillière, Tindall & Cox.) 35s.

Operative Surgery. By ALEXANDER MILES, M.D., LL.D., F.R.C.S. Ed., Consulting Surgeon, Royal Infirmary, Edinburgh; and D. P. D. WILKIE, M.D., F.R.C.S. Ed. and Eng., Professor of Surgery, University of Edinburgh. Demy 8vo. Pp. 590 + xviii, with 321 illustrations. 1933. London: Humphrey Milford. 21s. net.

The Duodenum: Its Structure and Function, its Diseases and their Medical and Surgical Treatment. By EDWARD L. KELLOG, M.D., F.A.C.S., Professor of Surgery and formerly Professor of Gastro-enterology, N.Y. Polyclinic Medical School. Imperial 8vo. Pp. 855 + xxviii, with 287 illustrations. 1933. New York: Paul B. Hoeber Inc. $10.

Diseases of the Spinal Cord. By WILLIAMS B. CADWALADER, M.D., Professor of Clinical Neurology, University of Pennsylvania Medical School, etc. Royal 8vo. Pp. 204 + xviii, with 72 illustrations. 1932. London: Baillière, Tindall & Cox. 29s.

Surgical Operations. A Textbook for Students and Nurses. By E. W. HEY GROVES, M.D., B.Sc., M.S., F.R.C.S., Consulting Surgeon, Bristol General Hospital, etc. Third edition. Royal 8vo. Pp. 263 + viii, with 204 figures in the text and an appendix illustrating instruments. 1933. London: Humphrey Milford. 18s. net.

An Elementary Handbook on Radium and its Clinical Use. By D. F. CLEPHAN, Full-time Assistant under the Medical Research Council at the Barnato Joel Laboratories, Middlesex Hospital; and H. M. HILL, Radium Officer at the Royal Free Hospital. Sm. post 8vo. Pp. 164 + xiii. Illustrated. 1933. London: Humphrey Milford. 7s. 6d. net.

Royal Berkshire Hospital Reports, 1933. Edited by H. S. LE MARQUAND, M.D. (Lond.), M.R.C.P. Royal 8vo. Pp. 160. 1933. Reading: The Royal Berkshire Hospital. 10s. 6d. net.

A Surgeon's Pocket Book. By H. S. SOUTTAR, D.M., M.Ch. (Oxon.), F.R.C.S., Surgeon, London Hospital. F'cap 8vo. Pp. 285 + viii. 1933. London: William Heinemann (Medical Books) Ltd. 7s. 6d. net.

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